GARDNER DENVER®

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2nd Edition
June, 1997

PLUNGER PUMPS

TRIPLEX MODELS

TQB (GD25T)
TQW (GD45T)
TQC (GD50T)
TAC (GD60T)
TDD (GD100T)
TAE (GD150T)
TDE (GD180T)
TFE (GD200T)

QUINTUPLEX MODEL

QBX (GD135Q)

OPERATING AND SERVICE MANUAL

Gardner Denver

MAINTAIN PUMP RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER PARTS AND SUPPORT SERVICES

Gardner Denver® and OPI® genuine pump parts are manufactured to original tolerances and designed for optimum dependability. Design and material innovations are the result of years of experience with hundreds of different pump applications. Reliability in materials and quality assurance are incorporated in our genuine replacement parts.

Your authorized Gardner Denver and OPI distributor offers all the backup you'll need. A worldwide network of authorized distributors provides the finest product support in the pump industry.

Your local authorized distributor maintains a large inventory of genuine parts and he is backed up for emergency parts by direct access to the Gardner Denver Machinery Inc. Master Distribution Center (MDC) in Memphis, Tennessee.

Your authorized distributor can support your Gardner Denver and OPI pump needs with these services:

1. Trained parts specialists to assist you in selecting the correct replacement parts.
2. Repair and maintenance kits designed with the necessary parts to simplify servicing your pump.

Authorized distributor service technicians are factory–trained and skilled in pump maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair services.

For the location of your local authorized Gardner Denver and OPI distributor refer to the yellow pages of your phone directory or contact:

Distribution Center:
Gardner Denver Machinery Inc.
Master Distribution Center
5585 East Shelby Drive
Memphis, TN 38141
Phone: (901) 542–6100
Fax: (901) 542–6159

Factory:
Gardner Denver Machinery Inc.
1800 Gardner Expressway
Quincy, IL 62301
Phone: (217) 222–5400
Fax: (217) 223–5897

INSTRUCTIONS FOR ORDERING REPAIR PARTS

When ordering parts, specify Pump MODEL and SERIAL NUMBER (see nameplate on unit). The Serial Number is also stamped on top of the cylinder end of the frame (cradle area).

All orders for Parts should be placed with the nearest authorized distributor.

Where NOT specified, quantity of parts required per pump or unit is one (1); where more than one is required per unit, quantity is indicated in parenthesis. **SPECIFY EXACTLY THE NUMBER OF PARTS REQUIRED.**

DO NOT ORDER BY SETS OR GROUPS.

To determine the Right Hand and Left Hand side of a pump, stand at the power end and look toward the fluid end. Right Hand and Left Hand are indicated in parenthesis following the part name, i.e. (RH) & (LH), when appropriate.

FOREWORD

Gardner Denver® and OPI® pumps are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day–to–day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

⚠ DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard–related.

For Part List information, see:

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SECTION 1
DANGER NOTICES

⚠ DANGER

Read and understand the following DANGER NOTICES before moving or operating the pump or any pump package unit equipment.

Reciprocating pumps are machines capable of producing high fluid pressures and flow rates and are designed to be used with proper care and caution by trained, experienced operators. **TO AVOID PERSONAL INJURY, DEATH AND/OR EQUIPMENT DAMAGE, READ AND THOROUGHLY UNDERSTAND THE FOLLOWING DANGER NOTICES PLUS THE ENTIRE OPERATING AND SERVICE MANUAL BEFORE ATTEMPTING TO MOVE OR OPERATE THE PUMP**. Contact a Gardner Denver Machinery service representative if you are unable to comply with any of the danger notices or procedures described in these documents.

Closely examine the data plate upon pump delivery to become thoroughly familiar with the operating limits for this pump model. **The pump must <u>never</u> be operated at speeds, pressures or horsepower exceeding the maximum values shown on the data plate or at speeds below the minimum shown. Failure to observe the operating limits shown on the data plate could result in personal injury, death, and/or equipment damage and will void the warranty**. Alterations to the pump, or application of the pump outside the data plate limits, must not be made without Gardner Denver Machinery written approval together with a new data plate, as dangerous operating conditions could result.

THE DANGER NOTICE AND DATA PLATES PROVIDED ON THE EQUIPMENT MUST NOT BE REMOVED, PAINTED OVER, HIDDEN OR DEFACED. They must be replaced if they become damaged or unreadable. Provisions should be made to have the following written danger notices plus the pump operating and service manual readily available to operators and maintenance personnel. In addition, copies of all pump system accessory component (e.g. pressure relief valve, pulsation dampener, suction stabilizer, engine, electric motor, etc.) operating and service manuals should be readily available for operator and maintenance personnel use. Read and follow all the precautions and instructions contained in these manuals. If any of these documents are lost or become illegible they must be replaced immediately. The danger notices plus the operating and service manuals should be reread periodically by both operators and maintenance personnel to refresh their memories in safe procedures and practices.

Keep in mind that full operator attention and alertness are required when operating high pressure pumping equipment. Operators should not begin or continue operations when tired, distracted or under the influence of alcohol or any type of prescription or nonprescription drugs.

The timely replacement of expendable parts and any other worn or damaged parts can prevent equipment damage and possible injury. The original parts used in Gardner Denver pumps are designed and tested to exacting standards to provide high quality performance and durability. Your best insurance in maintaining these characteristics is to use genuine Gardner Denver replacement parts.

A broad range of danger notices are covered on these pages, however, they cannot substitute for training, experience and common sense in the safe operation of high pressure pumping equipment.

<u>HAMMER LUG FASTENERS</u>

⚠ DANGER

On pumps or pump package units equipped with hammer lug connectors and/or hammer lug valve covers the following precautions must be observed to avoid personal injury, death and/or equipment damage due to contact with the hammer, hammer bar, broken parts from the hammer, hammer bar or lugs or other objects propelled by hammer blows. When tightening or loosening hammer lug connectors and valve covers, operators or maintenance personnel should:

- Inspect the hammer, hammer lugs and hammer bar, if one is used, to insure they are all in good condition. Replace any of these parts which are cracked, damaged or badly worn.
- Wear safety shoes and goggles.
- Alert other personnel to move away from the area.
- Check to insure they have safe footing.
- Fully engage the hammer bar, if one is used, to prevent it from disengaging violently from the cover as a blow is struck.
- Wipe their hands and the hammer handle and maintain a firm grip on the handle to avoid los-

ing control of the hammer while swinging and striking.

- Carefully swing the hammer to avoid striking themselves, another person and objects other than the targeted lugs or hammer bar.
- Avoid swinging the hammer above shoulder height.

VALVE SEAT PULLING

DANGER

The following precautions must be observed by operators and maintenance personnel to avoid personal injury, death and/or equipment damage from contact with the puller, hammer, wedge or broken parts from these components when using either a hydraulic or wedge valve seat puller. Operators or maintenance personnel should:

Hydraulic Puller

- Wear safety shoes and goggles.
- Chain or tie the jack down as it will jump violently when the valve seat disengages from the valve deck.
- Check to insure the pressure applied by the hydraulic pump does not exceed the hydraulic ram maximum pressure rating.

Wedge Puller

- Grind off any mushroomed material from the wedge before use.
- Inspect the hammer and wedge to insure they are in good condition. Replace any of those parts which are cracked, damaged or badly worn.
- Wear safety shoes and goggles.
- Check to insure they have safe footing.
- Fully engage the wedge to prevent it from disengaging violently from the cover as a blow is struck.
- Wipe their hands and the hammer handle and maintain a firm grip on the handle to avoid losing control of the hammer while swinging and striking.
- Carefully swing the hammer to avoid striking themselves, another person and objects other than the targeted wedge.
- Avoid swinging the hammer above shoulder height.

COVERS AND GUARDS

DANGER

Personal injury, death, and/or equipment damage can result from contact with moving parts. All moving parts must be equipped with covers and guards. All covers and guards must be securely positioned at all times when the unit is in operation.

Covers and guards are intended to not only protect against personal injury or death, but to also protect the equipment from foreign object damage.

EQUIPMENT MOVING AND LIFTING

DANGER

Heavy equipment including pumps, pump package units and components should only be moved or lifted by trained, experienced operators, who are physically and mentally prepared to devote full attention and alertness to the moving and lifting operations. An operator should be fully aware of the use, capabilities, and condition of both the equipment being moved and the equipment being used to move it.

DANGER

Failure to follow safe and proper pump, pump package or component lifting or moving procedures can lead to personal injury, death and/or equipment damage from shifting, falling or other unexpected or uncontrolled equipment movements.

Make sure the hoist, lift truck, ropes, slings, spreader, or other lifting equipment you are using is in good condition and has a rated lifting capacity equal to or greater than the weight being lifted. Lifting devices must be checked frequently for condition and continued conformance to rated load capacity. They should then be tagged with the inspected capacity together with the date of inspection.

Fully assembled pumps and pump package units are heavy and should only be moved using the specified lifting lugs or attachments.

Many individual components have lifting eyes or lugs which must not be used to lift assemblies, as they are designed to bear the weight of the component only.

Before lifting the individual component check to insure the lifting attachment is firmly secured to the component with undamaged, properly torqued fasteners, sound welds, or other secure attachments. Examine the lifting eyes, lugs, slots, holes or other projections to insure they are not cracked, otherwise damaged or badly worn. The repair of existing or addition of new welded lifting eyes, lugs or other projections should only be performed by experienced, qualified welders.

Package units should be lifted with spreaders connected to the lifting attachments normally built into the package unit support skid. Packages too large to lift fully assembled should be separated into smaller loads.

For these smaller loads the lifting devices should be fastened to the lifting attachments normally built into the individual motor, engine, pump or transmission/ torque converter, or their separate support skids.

When lifting subassembled components, for example a suction stabilizer attached to suction piping or a discharge pulsation dampener attached to a strainer cross and piping, use special lifting slings designed to safely support the combined weight of the components.

If a crane or hoist is being used to lift large components or assemblies, one or more persons should assist the operator from the ground with guide lines attached to the equipment being moved to properly position it and prevent uncontrolled movement.

When you start to lift a pump, package unit, subassemblies or individual components and you observe the equipment is tilting, or appears unbalanced, lower the equipment and adjust the lifting device to eliminate these improper lifting conditions before proceeding to move the equipment.

It is poor practice and dangerous to allow the equipment to pass over or close to your body or limbs. Be prepared to move quickly out of danger if equipment starts to fall, slip or move unexpectedly toward you.

PRESSURIZED PUMP SYSTEMS

⚠ DANGER

Fluids under high pressure can possess sufficient energy to cause personal injury, death and/or equipment damage either through direct contact with escaping fluid streams or by contact with loose objects the pressurized fluid propels.

Operating a pump against a blocked or restricted discharge line can produce excessive pressures in the entire discharge system, which can damage or burst discharge system components.

⚠ DANGER

Never operate a pump without a properly sized pressure relief valve located in the flowing discharge line immediately adjacent to the pump discharge connection.

The relief valve should be placed in the flowing discharge line and not at the opposite end of the discharge manifold in a dead end connection. The dead end may become clogged with solid material carried in the fluid, which could prevent proper relief valve operation.

⚠ DANGER

Never place a shut–off valve or any other component between the pump discharge connection and the pressure relief valve.

Make sure the pressure relief valve is installed so any pressurized relief discharge from the valve is directed away from possible contact with people or equipment. The relief valve must be set to relieve at a pressure equal to or below the maximum pressure values shown on the pump data plate. However, if a component is used in the discharge system with a lower rated pressure capability than that listed on the pump data plate,

the pressure relief valve must be set to relieve at a pressure equal to or below the rated capability of the lowest rated component.

Before starting the pump every time, check to insure:

- The pressure relief valve is in good operating condition and has been set to the proper relief pressure.
- Any pipe line used to direct pressurized relief flow to another location, such as a collecting tank, is not blocked.
- The discharge system is not blocked and all the discharge line valves are open.

Check all fluid end discharge system components including pipe, connections, elbows, threads, fasteners, hoses, etc., at least once every six months to confirm their structural adequacy. With time, wear, corrosion and fatigue can reduce the strength of all components. Magnetic iron and steel components should be checked with magnetic particle or dye penetrate crack detection equipment. Nonmagnetic materials should be checked for cracks with dye penetrants. All metallic components should also be visually checked during these inspections for signs of corrosion. If a component shows evidence of cracking or loss of material due to corrosion it must be replaced with a new part.

Continually monitor suction and discharge hose assemblies when the pump is operating for leakage, kinking, abrasion, corrosion or any other signs of wear or damage.

Worn or damaged hose assemblies should be replaced immediately. At least every six months examine hose assemblies internally for cut or bulged tube, obstructions and cleanliness. For segment style fittings, be sure that the hose butts up against the nipple shoulder, the band and retaining ring are properly set and tight and the segments are properly spaced. Check for proper gap between nut and socket or hex and socket. Nuts should swivel freely. Check the layline of the hose to be sure that the assembly is not twisted. Cap the ends of the hose with plastic covers to keep them clean until they are tested or reinstalled on the pump unit. Following this visual examination, the hose assembly should be hydrostatically tested, on test stands having adequate guards to protect the operator, per the hose manufacturer's proof test procedure.

Fluid end component inspections should be performed more frequently than every six months if pressures above 2500 psi are used in the discharge system or if corrosive, flammable or hot (over 110° F) fluids are being pumped.

Proper stuffing box packing selection is important for safe pump operation. Contact a Gardner Denver Machinery service representative for assistance in selecting the proper packing before beginning operation.

Before starting the pump the first time and periodically thereafter check the pump, suction and discharge system fastener torques versus the values listed on page 12 to insure proper tightness. Over and under torquing can damage threaded pipes, connections and fasteners, which may lead to component damage and/or failure. Replace all components found to be damaged or defective. On pumps equipped with stuffing boxes, the gland must be engaged by at least three (3) threads to hold the discharge pressure of the pump.

⚠ DANGER

Do not attempt to service, repair, adjust the plunger packing or otherwise work on the pump while the unit is operating. Shut off the pump drive motor or engine and relieve the fluid pressure in the pump suction and discharge systems before any work or investigation is performed on the pump or pump systems.

Block the crankshaft from turning and make certain that all pump drive motor or engine start switches or starter controls are clearly tagged with warnings not to start the pump while repair work is in process.

Whenever the pump is operating, continually monitor the entire suction, discharge and pump lubricating systems for leaks. Thoroughly investigate the cause for leakage and do not operate the pump until the cause of the leak has been corrected. Replace any parts which are found to be damaged or defective. When a gasketed joint is disassembled for any reason, discard the used gasket and replace it with a new, genuine Gardner Denver gasket before reassembling the joint.

Due to the high working pressures contained by the fluid cylinder, discharge manifold and discharge piping, welding on these components is not recommended. If welding on the discharge system cannot be avoided, only experienced, qualified welders should be used. In addition, the welded part should be hydrostatically proof tested in the shop with water or hydraulic fluid to one and one half times maximum discharge system working pressure, with no observable fluid leakage, before the part is reinstalled in the pump system.

In summary, high pressure fluid streams can possess

sufficient energy to cause personal injury, death and/or equipment damage. These results can occur either through direct contact with the fluid stream or by contact with loose objects the fluid stream has propelled, if the pump system is improperly used, or if the fluid is misdirected, or allowed to escape from defective or improperly maintained equipment.

FLAMMABLE, HOT, COLD OR CORROSIVE FLUID PUMPING

⚠ DANGER

Extreme caution must be exercised by trained and experienced operators when flammable, hot, cold or corrosive fluids are being pumped, in order to avoid personal injury, death and/or equipment damage due to explosion, fire, burn, extreme cold or chemical attack.

Never operate a pump which is pumping hydrocarbons or other flammable, hot, cold, or corrosive fluids when any part of the pump, suction system or discharge system is leaking. Stop the pump immediately if any leakage, other than a few drops per minute of packing weepage, is observed. Keep all flame, sparks, or hot objects away from any part of the pump, suction system, or discharge system. Shield the pump, suction system and discharge system to prevent any flammable, hot, cold or corrosive fluid leakage from dripping or spraying on any components, flame, sparks, hot objects or people. Inspect the plungers, packing, gaskets and seals for fluid leakage frequently and replace all worn or leaking parts.

Selection of the proper gaskets, seals and stuffing box packing is even more critical when flammable, hot, cold or corrosive fluids are being pumped than when other, inherently less dangerous fluids are used. Contact a Gardner Denver Machinery service representative for assistance in selecting the proper gaskets, seals and packing before beginning operation.

Since some packing weepage into the cradle area is inevitable, the drain at the bottom of the cradle must be connected to a drain line which conducts the fluid leakage to a collection container located in a protected area. The entire drain system and container must be constructed of materials resistant to attack from the pumped fluid or from explosion or fire of the pumped fluid. **Heavy duty cradle covers must be securely fastened in the proper position on the pump at all times when the pump is operating. If the pumped fluid releases harmful, explosive or flammable vapors the covers must be vented to conduct the fumes away from the pump unit to a nonhazardous area**.

Before beginning pumping operations or starting the pump power source (whether an engine or electric motor) check the atmosphere all around the pumping site for the presence of flammable or explosive vapors. Do not begin operation and stop ongoing operation if flammable or explosive vapors are detected. Hot surfaces, sparks, electric current or engine exhaust could ignite flammable or explosive vapors. Each engine used as a power source on pumping units where flammable or explosive vapors could form should be equipped with an air inlet shut–off. If flammable or explosive vapors are present in the pumping site atmosphere, an engine could continue to run on these vapors even after the engine fuel line is shut–off if an air inlet shut–off is not used.

In addition, on pumping units used where flammable or explosive vapors could form, all electric motors used as power sources must be of explosion proof construction and all electrical components and wiring must meet the current National Electrical Code for explosive atmospheres.

These precautions must be taken to avoid possible personal injury, death and/or equipment damage from explosion, fire or burns.

HIGH PRESSURE LIQUID JETTING, BLASTING AND CLEANING

⚠ DANGER

Extreme caution must be exercised if any type of wand, gun, nozzle or any other pressure and flow directing device is attached to the pump discharge system for use in jetting, blasting, cleaning, etc. This type of equipment must be used with utmost care by trained, experienced operators. High pressure fluid streams can either by direct contact or by propelling loose objects, cause serious personal injury or death to the operators and/or other persons.

Pressure or flow directing devices often receive pressurized flow through flexible hoses, which can burst if

they are kinked, cut, abraded or are otherwise worn, damaged or pressured above their rated capacity. Protect the hose and connections from damage by people, objects and vehicles. A broken, cut or otherwise burst hose can release pressurized fluid which may cause personal injury, death and/or equipment damage.

High pressure fluid from hand held or hand directed pressure and flow directing devices may overpower an operator's ability to control or direct the device, which could lead to personal injury, death and/or equipment damage. The operator must brace against the backward thrust of a hand held device. In addition, a safety harness or safety net must be used when working in an area where the operator could be injured in a fall. Stand to the side of any tubing or container being sprayed to avoid back spray and never operate a hand held device above shoulder level.

Never direct the pressurized fluid stream at yourself or any other person, control valves, the pump, pump drive, suction or discharge systems. The pressurized stream can cause serious personal injury or death and can also change valve or control settings which could dangerously increase the delivery pressure to the pressure and flow directing device.

When operating a pressure and flow directing device, use only equipment which automatically shuts off flow when an operator releases hand or foot pressure on the pressurized flow trigger control to prevent injury if the operator is overpowered or becomes disabled.

Check to insure this automatic shut–off equipment is operating properly before every use and never circumvent the automatic shut–off for any reason or by any means when operating the equipment.

When operating any type of high pressure liquid jetting, blasting or cleaning devices the operators must always wear protective clothing including, but not limited to, a hard hat with full face visor, heavy duty rain coat and pants, boots with nonskid sole and safety toe, rubber gloves with rough grip surface and ear noise protection.

Full operator attention and alertness are required when operating this equipment to avoid personal injury, death and/or equipment damage. The operators should take frequent rest breaks and cease operations when they become tired or distracted.

Before the equipment is started, the work area must be inspected and properly prepared to avoid personal injury, death and/or damage to equipment. Make sure the work area is checked for hazardous fumes, has adequate ventilation for engine exhaust and sufficient drainage for released fluid. Check the work area for electrical equipment, connections, outlets, fixtures, or lines. If any are present they must be made water tight and the electrical power to these devices must be shut off to avoid electrical shocks from fluid contact. The work area should be clearly marked and roped off to keep unauthorized people and vehicles from entering. Remove all loose parts, tools and equipment from the work area before beginning operation.

All pressure containing devices including wands, nozzles, guns, hoses, connections, etc., should be regularly checked for condition. These components should all be tagged with their tested pressure capabilities together with the date testing was performed. **Always be aware of the pressure level in the system and never connect any equipment to the system which has a rated or tested pressure capability below the system operating pressure**. The equipment must be shut down and the system pressure released before changing or disconnecting wands, nozzles, guns, hoses, connections or any other pressurized system components.

All pressure containing devices including wands, nozzles, guns, connections, etc., plus all automatic shut–off, pressure and control equipment should be treated with care. Protect them from damage by people, objects and vehicles. **Never** lay them in dirt, mud, ice or other loose material which could plug the fluid opening or interfere with their operation. **Never** use the wand, nozzle, gun, etc. to pry loose material off items being cleaned.

Before starting operation in a cold environment, check to make sure there is no ice in the fluid system and repeat this inspection each time before operation is restarted.

Before purchasing wands, nozzles, guns, connections, and hose, etc., manufacturers of these components should be contacted for detailed information on the design and safety features incorporated in their products. After careful study of various manufacturers products, we recommend that **only** those wands, nozzles, guns, connections and hose, etc., be considered for purchase that you judge to offer the highest quality of design, construction and safety, since these components are among the most critical to the safe operation of high pressure liquid jetting, blasting and cleaning equipment.

After you have selected and purchased these components, follow the manufacturer's instructions completely in their use.

In summary, high pressure jetting, blasting and cleaning are inherently dangerous, as the pressures and flow rates needed to remove scale, clean, etc. are sufficient to cause personal injury, death and/or equipment damage resulting from, but not limited to, any of the conditions described in the above Danger Notices.

SECTION 2
OPERATING AND MAINTENANCE INSTRUCTIONS

⚠ DANGER

Always wear safety shoes and goggles when operating and performing maintenance or repair on a pump or pump package unit to help prevent personal injury to eyes and toes from pressurized fluids and falling or flying objects.

INSTALLATION

LOCATION – The pump should be located as close to the fluid supply as possible. A short, straight suction line will provide the best pump performance and reduces the possibility of cavitation.

The pump must be driven in the direction indicated by arrows on the frame, that is, the crankshaft must rotate over center toward the crosshead oil trough. Rotation in this direction is necessary to assure adequate crosshead and crosshead bushing lubrication.

Adequate space should be provided around the pump for ease of inspection and service. The pump must be leveled and checked for gaps under all frame feet. Shim any gaps to prevent frame damage when the feet are securely fastened to the foundation or base. Pump frame damage may also occur on truck mounted units due to truck frame flexing, unless a stiff base or isolators are used between the pump and truck frames.

The maximum allowable temperature of the pumped fluid is 200°F (93°C). Any pump application over this temperature, or with a suction pressure over 50 psi, must be approved in writing by Gardner Denver Machinery Inc. Marketing.

SUCTION SYSTEM – Suction system conditions are critical to proper pump performance and durability. Adequate suction pressure, as shown on the NPSHR graph, page 27, must be provided at the pump suction connection.

The suction pipe or hose should be the full size of the pump inlet opening. If the suction line is relatively long, the next larger size pipe or hose should be used. The suction line should have a very slight, constant upward grade toward the pump to insure air pockets do not form in the line. The suction line must also be air–tight. Both air pockets and air leaking into the line will reduce the pump volumetric efficiency and produce shock loading inside the pump. Any bends in the suction line should be long radius sweeps. All piping must be supported independently of the pump to insure that no strain is imposed on the pump by misalignment, vibration or improperly fitted pipe. Any suction line shutoff valve(s) must be full opening to avoid choking the pump.

⚠ WARNING

The suction line strainer, if used, must be cleaned frequently. A clogged or partially clogged strainer can cause severe pump cavitation, poor expendable part life and potentially serious pump damage.

Many potential pumping problems can be avoided by reviewing the proposed pump layout and suction conditions with Gardner Denver Machinery Inc. Marketing before a pump is purchased.

PRESSURE RELIEF VALVE – The pump must be protected from excessive discharge pressure by a pressure relief valve. This valve must be properly sized to handle the full flow of the pump and must be installed as close to the pump discharge connection as possible.

⚠ DANGER

Never install a shutoff valve in the line between the pressure relief valve and the pump cylinder, as pumping against a closed valve could produce pressures sufficient to cause property damage and/or serious personal injury or death.

⚠ DANGER

Improper use or maintenance of pressure relief valves can cause excessive pressure which may result in property damage and/or serious personal injury or death.

The relief valve should be set to operate at approximately 1.1 times the discharge pressure, but MUST NOT exceed equipment tolerances and ratings.

Check the valve for proper functioning at lease once a month.

STARTING A NEW PUMP – The power end inspection plate should be removed and the crankcase examined. Clean out any dirt or moisture that may have accumulated during shipping or storage. Check all pump fasteners for proper tightness.

⚠ WARNING

Pumps are shipped from the factory without oil in the crankcase.

Add oil through the opening where the breather is located. The breather is threaded either into the top of the frame, or into an elbow attached to the upper part of the frame end plate. Fill the crankcase with the quantity of oil shown on the nameplate attached to the pump frame. Refer to the lubrication data plate and LUBRICATION section, below, for the proper oil specification.

⚠ DANGER

The cradle cover, all guards and inspection plates must be securely fastened in proper position before the pump is started and must not be removed at any time when the pump is in operation, to avoid personal injury and/or death from moving parts.

⚠ WARNING

The pump must be primed at start–up to prevent damage to packing and plungers.

The pump should be started slowly, but should never be run below the minimum speed shown in the back of the manual. The pump should not be started under load and should be operated for several hours with practically no discharge pressure. A start–up bypass line should be used whenever the pump is started, to gradually bring the pump up to working speed and pressure. After the pump has run a short time, check the oil level as it may be necessary to add a small amount of oil to compensate for the oil adhering to the crankcase walls and moving parts.

The oil level in the TQ model pumps is checked when the pump is not running. The proper fill for these pumps occurs when the oil is level with the top of the elbow threaded into the lower portion of the frame end plate.

The oil level on TA, TD, TF and QB model pumps should be checked with the pump running. The running level on these pumps should be between the middle and top of the sight glass in the oil level indicator, located on the side of the pump frame. Add oil to all pumps through the threaded opening where the breather is mounted. The breather is threaded into the top of the frame, or into an elbow attached to the frame end plate. The pump may then be brought up to working speed and pressure. Check for overheating and listen for abnormal noise. Inspect all joints in the suction line to be sure there are not air or fluid leaks. Check for excessive vibration caused by improper suction conditions. Be sure the stuffing box packings are properly lubricated per the directions given in the packing lubricator section.

LUBRICATION – The crankshaft, crossheads, connecting rods and main bearings are lubricated by oil in the crankcase.

⚠ WARNING

Use only extreme pressure, API GL–5 gear oil, having the required additives and viscosity, in the crankcase. The use of motor oils in the crankcase does not provide acceptable lubrication and voids the warranty.

The selected API GL–5 oil must have antiwear, antifoaming, noncorrosive and rust inhibiting additives. A list of recommended grades vs. temperatures is located on page 24, and on the pump lubrication data plate.

The list is based on premium quality oils having viscosity values that do not exceed 7000 SSU at the minimum start–up oil temperatures listed and viscosity values between 1500 SSU and 200 SSU for the crankcase oil temperatures listed. Oils with viscosity values significantly different from these values, at the temperatures listed, may be too thick at low temperatures to flow into close bearing clearances, or may be too thin at high temperatures to carry the required loads. In either case pump damage could occur.

If a 7000 SSU maximum viscosity at start–up cannot be assured, a crankcase heater is required. Also if crankcase oil temperatures exceed 200°F (93°C), an oil heat exchanger with a circulating pump is required to prevent seal damage and oil break down.

For outdoor operation, multiviscosity oils are preferred to provide acceptable lubrication over wide temperature ranges. However, when multiviscosity oils are not available, straight weight oils should be acceptable, if care is taken to stay within the listed temperature ranges. Straight weight oils are also ideal in pumps used indoors, when ambient temperatures are controlled.

The oil level in the pump should be checked frequently. Add oil through the breather opening. The breather can be removed by rotating it counter clockwise. Keep the breather tightly in place while the pump is operating to prevent moisture and dirt from entering the crankcase. On pumps equipped with a replaceable filter element type breather, clean the element frequently and replace the element every six months. When operating in very dusty or dirty conditions, more frequent replacement may be necessary.

⚠ WARNING

The oil should be checked for contamination whenever pumped fluid sprays or splashes against an oil stop head. This is especially critical when the fluid contains salts or solids, as these contaminants can plug lubricating passages and cause rapid power end failure.

The time between oil changes depends on the pump location and operating conditions. Ordinarily, if the crankcase is kept closed, the normal change interval is 1000 hours. However, the oil must be changed any time water or other contamination is found in the oil.

On pumps equipped with a magnetic drain plug, check the magnet for metal chips whenever the oil is drained. If chips are found, remove the frame end plate and the plugs over the crosshead oil reservoir. Clean and flush the crankcase through these openings before adding a fresh oil fill.

Some operating conditions and/or oil brands produce excessive oil foaming, even when the specified GL–5 oils containing antifoaming additives are used. Oil foaming can cause pump damage, as oil bubbles will not lubricate moving parts properly. If significant oil foaming occurs, contact Gardner Denver Machinery Inc. Marketing or Service for the current factory recommended defoamant to be added to the lubricating oil. When it is not possible to contact Gardner Denver, a small amount of kerosene added to the oil will usually reduce foaming. One half of a fluid ounce of kerosene added to each gallon of oil should be sufficient to control foaming. The use of larger amounts of kerosene per gallon of oil will reduce the oil viscosity, which could result in rapid pump wear and failure.

If the pump has been stored or shut down for an extended period, the crankcase should be drained and filled with new oil before start–up.

OPERATION – The pump should always be started slowly, with little or no discharge pressure, to give the oil time to warm–up and flow to all the bearing surfaces. This warm–up is especially important during cold weather operation.

⚠ WARNING

The pump must never be operated in reverse direction, at pressures or speeds above the maximum values shown on the nameplate, or at speeds below the minimum value shown in the back of the manual, without written permission of Gardner Denver Machinery Inc. Marketing.

Failure to observe this warning could result in severe pump damage due to overloading and/or lack of adequate lubrication.

FLUID END CORROSIVE ATTACK – Some aluminum bronze fluid cylinders and components (especially valve decks and seats) experience corrosive attack from chemicals in the water being pumped. To avoid damage to pump components, water containing corrosive chemicals should be treated to neutralize corrosive properties before it is pumped.

To determine if corrosive chemicals are present in pumped water, a sample should be chemically analyzed and/or one or more sacrificial anodes should be placed in the suction fluid stream. If the water analysis shows corrosive chemicals are present, or on frequent inspection the anode is observed to be eaten away, the fluid should be treated.

Anodes, mounted on threaded plugs, are available from Gardner Denver Machinery Inc. to replace one or more of the drain plugs located in the bottom of aluminum bronze suction manifolds.

SUGGESTED PERIODIC MAINTENANCE SCHEDULE

Item	Maintenance / Inspection	After 2–Hour Start–up	Daily	Weekly	Monthly	Every 3 to 4 Months
	POWER END					
1	Lubricator operation	X	X			
2	Lubricator sheave alignment and belt tension	X				X
3	Pump drive belt slippage	X	X			
4	Pump drive sheave alignment and belt tension	X				X
5	Plunger coupling condition	X	X			
6	Plunger coupling fastener torque	X			X	
7	Sheave fastener torque	X				X
8	Prime mover mounting fastener torque	X				X
9	Pump mounting fastener torque	X				X
10	Crankcase oil level and quality	X	X			
11	Crankcase oil change every 1000 operating hours (or sooner if contaminated)					
12	Any oil leaks	X	X			
13	Breather/filter element condition			X		
14	Extension rod to crosshead torque	X			X	
15	Connecting rod nut torque	X				X
16	Crankshaft bearing housing bolt torque	X				X
17	End play or preload crankshaft bearing	X				X
18	Baffle disc	X	X			
19	Lubricator oil tank level		X			
20	All exterior locking devices	X		X		
	FLUID END					
1	Packing Leakage	X	X			
2	Stuffing box condition (after packing replacement)	X	X	X		X
3	Any liquid leakage		X			
4	Fluid cylinder to frame nut torque	X				X
5	Suction/discharge manifold stud nut torques	X			X	
6	Stuffing box nut torque	X				X
7	Companion flange nut torque	X			X	
8	Valve assembly condition					X
9	Pump discharge relief valve setting and condition				X	
10	Packing gland tightness					
11	Plunger condition	X	X			
12	Suction/discharge valve cover fastener torque	X			X	

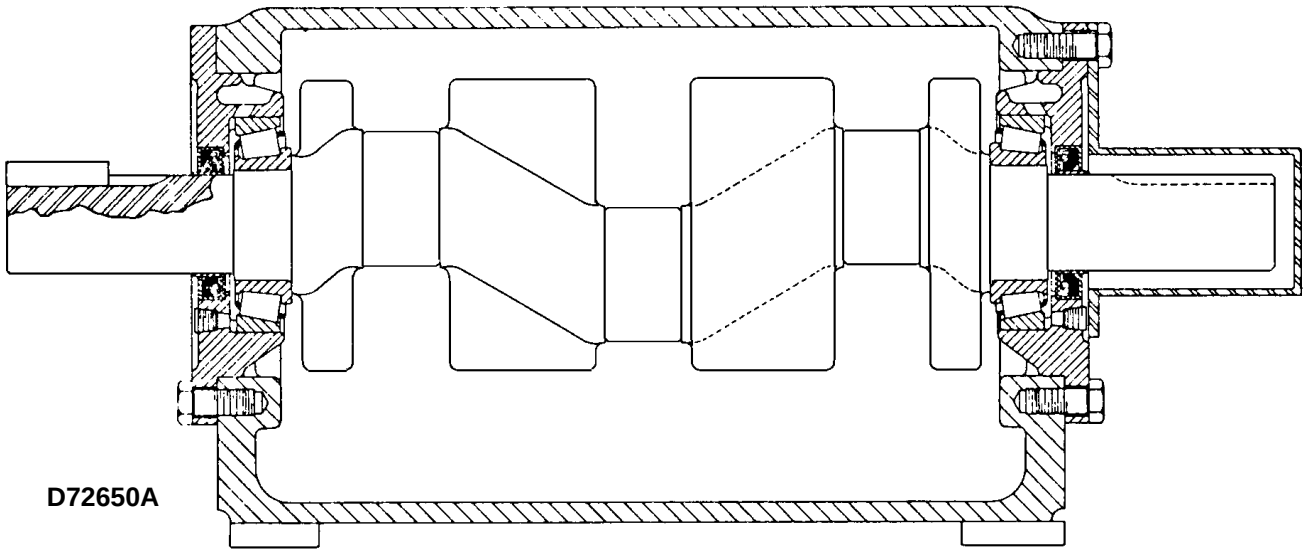


FIGURE 1 – REAR SECTIONAL VIEW OF TRIPLEX POWER END SHOWING CRANKSHAFT

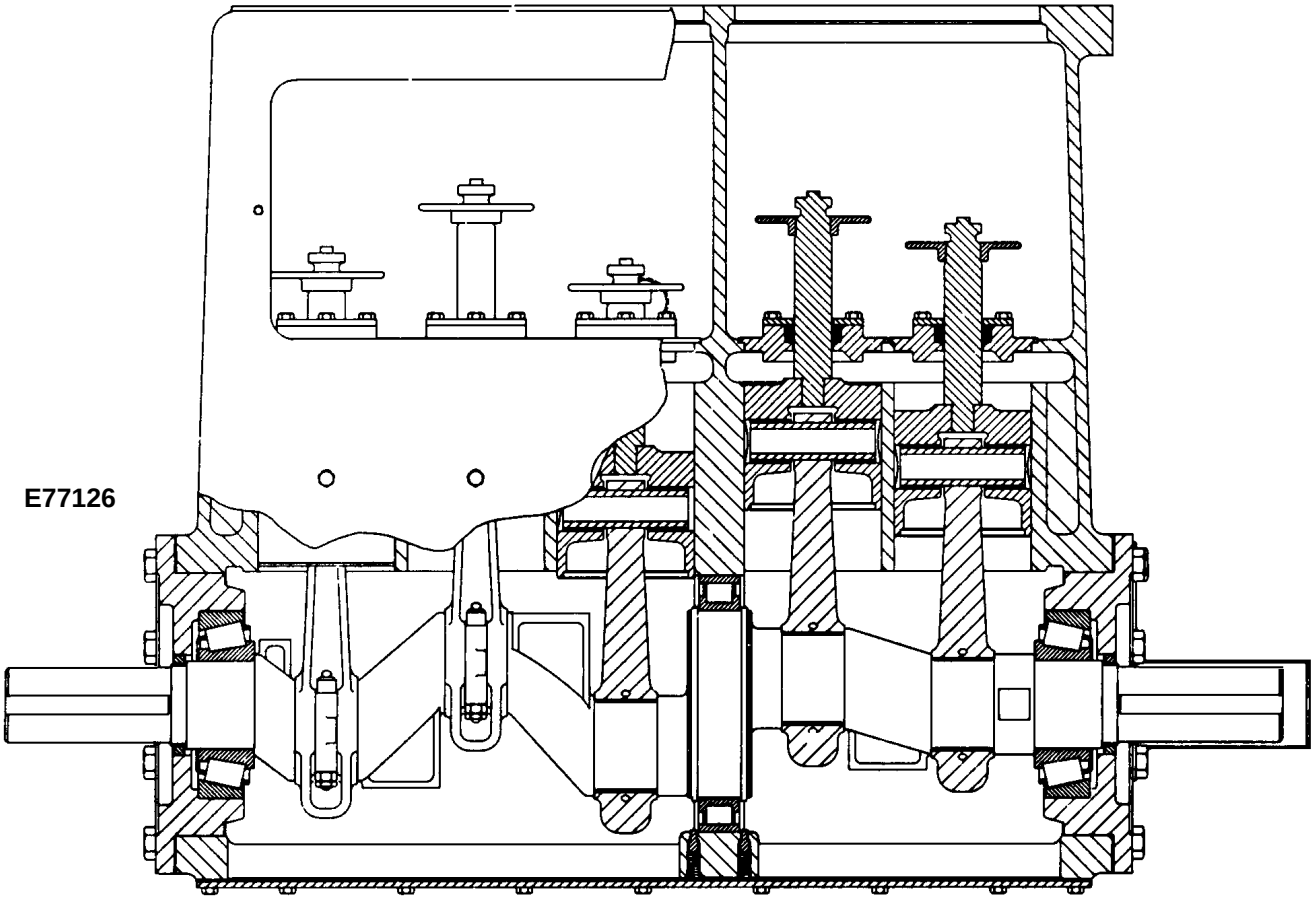


FIGURE 2 – TOP SECTIONAL VIEW OF QUINTUPLEX POWER END SHOWING CRANKSHAFT

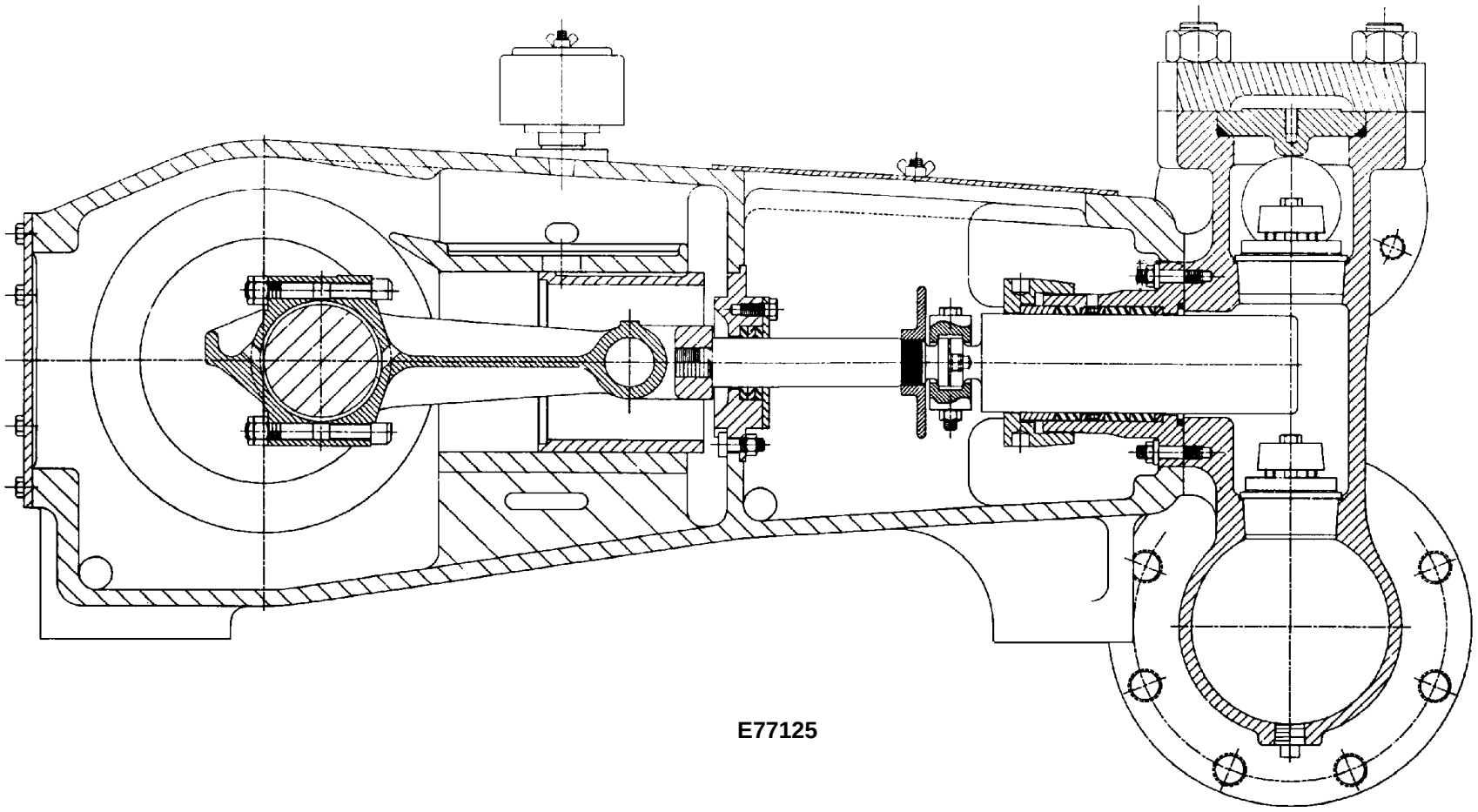


FIGURE 3 – SECTIONAL VIEW OF TRIPLEX AND QUINTUPLEX PLUNGER PUMPS

FLUID CYLINDERS – One piece cast fluid cylinders are made for low and medium pressure service in aluminum bronze for water and some other corrosive fluids and for some models in nodular iron for noncorrosive fluids. Cylinder suction and discharge openings are equipped with either flanges and studs or internal threads. All valve covers are secured with studs and nuts. Valve seats are held in by taper fit.

Block fluid cylinders are made for high pressure and/or corrosive fluids in steel, stainless steel or aluminum bronze materials. These fluid cylinders are made with removable bolt–on suction manifolds and, in some cases, bolt–on discharge manifolds. Cylinder suction and discharge openings are equipped with flanges and studs or bolt–on replaceable, internal threaded blocks. All valve covers are secured with studs and nuts. Valve seats are held in by either taper fit or are clamped between the cylinder and the manifolds.

Torques required to properly tighten fluid end fasteners are listed by model on pages 37 thru 63. These fasteners should be checked frequently for tightness. A loose or improperly torqued fastener may break under pulsating fluid end loads.

TAPERED SEAT VALVES – This type of valve is retained in the cylinder by the locking action of the matching valve seat and deck tapers.

The valves should be examined regularly for excessive wear and for coating or particle adhesion that may prevent proper valve opening and closing. A valve that is not sealing, opening or closing properly, or a seat that is improperly seated in the deck, can fail quickly by erosion of the valve, seat or deck.

Access to the discharge valves is gained by removing the valve covers on top of the cylinder. The valve covers are held in place by studs and nuts. The retainers or cages, springs and discs or valves must be removed before the seats can be inspected or pulled. The suction valves can be examined after the discharge valve seats have been removed with a valve seat puller. The suction valve seats are also removed with a valve seat puller.

The outside diameters of suction valve seats on all cylinders without suction valve covers are smaller than those on the discharge valves, to enable the suction valves to be installed and removed through the discharge valve decks. However, where the suction valve covers are used, the suction and discharge valves may use the same size seats.

Several different valve options are offered for the pump models covered by this manual. Consult Gardner Denver Machinery Inc. Marketing Department or your nearest salesman if you need help in deciding which valves to use.

DISC VALVES – This style of valve, made of either aluminum bronze or stainless steel, is used as standard equipment in low and medium pressure tapered seat deck fluid cylinders. Monel valves are also available for fluids that attack aluminum bronze and stainless steel. Delrin (or Celcon) discs are recommended for water and most clean fluids up to 160°F (71°C). Titanium discs are specified for fluids with higher temperatures, trace amounts of abrasives and with fluids that attack Delrin (but not titanium) discs.

The valve plate, springs and retainer are secured by a fastener that passes through these parts and threads into the seat. These parts can all be lifted out and inspected by removing the fastener. The seat should be removed, using the properly sized puller assembly shown in the pump parts list manual. Puller kits can be purchased as optional equipment from Gardner Denver Machinery Inc.

Note that two different types of puller heads are used to remove disc style valve seats. For larger seats, a slotted finger design head slips down through the seat openings and is then rotated to engage the seat ribs. For smaller seats, the seat openings are not large enough to use this design puller head. The smaller seat puller heads have a center threaded bolt or stud which screws into the threaded center hole in the seat.

⚠ DANGER

Wear eye protection when removing the valve seat as metal chips could be dislodged from the valve seat or valve puller and fly up into your face.

When preparing to remove a valve seat, tightly assemble the proper finger or threaded design puller head on the smaller thread end of the puller rod. Insert the puller head and rod into the valve cover opening on the top of the cylinder and either engage the puller fingers in the seat or tightly thread the head into the seat. Slip the puller plate onto the puller rod using the center hole in the plate. Lower and rotate the plate until two studs

on opposite sides of the valve cover opening line up with two holes in the puller plate. Continue lowering the plate over the studs until the plate rests on top of the cylinder. Place the stepped washer (stepped side up) over the puller rod and drop it down on the plate. Put the flat washer and then puller nut on the puller rod. Push the puller wedge between the stepped and flat washers with the two wedge legs straddling the puller rod and with the outer edge of one leg against the step on the stepped washer.

Continue pushing the wedge between the washers until the wedge leg tips reach the opposite edges of the two washers. Holding the wedge in this position, firmly tighten the puller nut with a properly sized wrench. The seat can then be pulled by striking the stem end of the wedge with a heavy hammer. This type of puller uses a combination of pull and impact to disengage the seat from the cylinder deck taper.

Do not use a hydraulic jack type seat puller with a disc valve seat that has a small threaded hole in the center used for both the retainer screw and seat pulling. The very strong, steady pull produced by a hydraulic puller is more likely to break the puller fastener than is the combination pull and impact the wedge puller provides.

A new valve as taken from the carton should be cleaned thoroughly with solvent and wiped dry with a clean cloth. Check tapered surface to be sure it has not been accidentally nicked or dented in handling. The valve assembly should be disassembled by removing the single fastener; be careful not to lose the small nylon thread lock plug.

⚠ WARNING

Never attempt to install the valves as an assembly. The valve could be damaged when a block and hammer are used to strike the retainer to set the seat.

Wipe the taper surface of the seat and pump port taper with a clean cloth. Lower the seat into port taper and then lift slightly and drop. If the seat drops straight, it will seize on the taper sufficiently that it cannot be pulled up by hand. It is necessary to strike the seat once to assure a perfect seat. This may be done with a short section of hard wood and a four–pound (1.8 kilogram) hammer. The end of the wood block placed against the valve seat should be large enough to cover the outer sealing ring. One sharp blow should be sufficient for proper seating. Additional hits may jar the seat loose and could damage the seat. Check the seat top surface to see that it has not been damaged after the seat has been installed.

After all suction valve seats have been installed, place the valve plates, springs and retainers in place, then secure with the retainer bolt. Carefully position the valve plate and retainer, so as not to pinch the plate closed or damage the guide while tightening the fastener. Torque the retainer bolt to the value shown in the table at the back of the manual. If the seat comes loose from the taper when the disc, spring and fastener are being installed, the valve must be disassembled before striking the seat again.

⚠ WARNING

It is possible to lock a valve closed by either mispositioning the retainer stem on top of the valve plate when the retainer bolt is tightened, or by overtightening the retainer bolt and expanding the retainer stem until it contacts the disc bore.

After all suction valves are in place, the discharge valves are installed in the same manner. Install the valve covers and gaskets. Tighten the cover stud nuts to the torque listed at the back of the manual.

WING GUIDED AND SEVERE DUTY VALVES – These valves are used in high pressure, tapered seat deck cylinders where pressures are too high for disc style valves. They are also used in low and medium pressure cylinders, where disc valves cannot tolerate fluids with high temperatures, abrasives or chemicals that attack the discs. Some of the wing guided and severe duty valves are offered with urethane insert options to handle high abrasive concentrations. However, the inserts will not hold up in fluids with temperatures above 160°F (71°C) or in fluids that attack urethane.

These valves are retained by a cage that screws onto the seat. A valve cage removal tool can be purchased from Gardner Denver Machinery Inc. Refer to the Parts List for the part number.

The wing guided valves can be removed with one of two types of puller heads, threaded on the puller rod. The first type head uses the retainer attaching threads on the top of the valve seat. Since only a few threads are required (and provided) to hold the cage to the seat, these threads can be easily damaged by a puller head if the seat is hard to pull. Therefore, a hydraulic jack seat puller is not recommended for use with this style puller head.

The second type of puller head uses a cam arrangement to pass through the seat opening and engage one side of the seat bottom. This type head is preferred since it is less likely to damage the seat during the pulling procedure. When using either type of puller head, follow the valve pulling procedure outlined in the disc valve section of this manual. The second type of puller head can be used with a hydraulic jack type puller.

⚠ DANGER

If a seat puller powered by a hydraulic jack is used, be certain to chain or tie the jack down as it will jump violently when the valve seat lets go.

The severe duty, tapered seat valves can be removed with one of two types of puller heads. The first type head has threads on the outside diameter that match the threads cut into the inside diameter of the seat. The second type head uses the same type cam arrangement described in the wing guided section above. When using either type of puller head, follow the valve pulling procedure described in the disc valve section of this manual. A hydraulic jack type puller can be used with either of these heads.

Before installing a valve, make sure the seats and deck tapers are clean and dry. Inspect both seats and deck tapers to insure they are not scratched, nicked or otherwise damaged. Replace any seat found damaged and have any damaged deck tapers remachined. Do not coat the tapers with any kind of lubricant or coating before assembly.

⚠ WARNING

Never attempt to install wing guided valves as assemblies as the valve cage will be damaged.

Drive the seat into the taper using a four–pound (1.8 kilogram) hammer striking either a wood block (covering the full upper surface of the seat) or one of the factory option valve seat drivers that thread onto the various style valve seats. One sharp blow on the block or the rod end of the driver should be sufficient for seating. If the seat jumps up when it is struck, take it out and inspect both the seat and the deck tapers. They must be clean, dry and undamaged before a second attempt is made to install the seat. Again use only one sharp blow on the block or driver after dropping the seat into the taper. Excessive pounding could loosen or damage the seat.

Some pump models use flat valve covers with gaskets, while others use round valve covers, O–rings and retaining plates. Inspect the valve cover and cylinder sealing surfaces to insure they are in good condition and install a new gasket or O–ring. Install either the flat cover, or the round cover, retainer plate and hardened steel washers, and tighten the stud nuts to the torque listed in the back of the manual.

CLAMPED SEAT VALVES – This type of valve is clamped between the fluid cylinder and either the suction or discharge manifold. The suction (front) and discharge (top) manifolds are held on the fluid cylinder with studs and nuts. These cylinders are designed for ease of valve replacement in high pressure services. Tapered valve seats are often difficult to remove from high pressure cylinders.

When replacing suction valves, remove the manifold stud nuts and slide the manifold outward on the studs until further movement is prevented by the built–in manifold retaining screws.

⚠ DANGER

Do not remove the expansion plugs and retaining screws when servicing suction valves. These parts stop the suction manifold from sliding off the ends of the studs and falling, which could cause equipment damage and/ or serious personal injury or death.

If flexible suction and discharge lines are not attached to the pump, the suction and discharge connections must be removed before the manifold can be slid away from the cylinder. After the manifold has been slid out, the valves can be removed, inspected and replaced as necessary. Before replacing the valves, inspect the valves, manifold and cylinder surfaces and the valve gaskets to insure they are not scratched, nicked or otherwise damaged. Make sure the cage is tightened on the seat to the torque level listed in the back of the manual. Install the gaskets in the valve grooves and position the valves in the cylinder bores with the cages in the cylinder. Slide the suction manifold along the studs and pilot the suction valve seat into the manifold. Tighten the suction manifold stud nuts to the torque value listed in the back of the manual.

If the suction manifold and/or fluid cylinder must be replaced, remove the expansion plugs and retainer screws (socket head capscrews) from the suction manifold. Support the suction manifold with straps and a hoist, so it cannot fall when the manifold is removed. Unscrew the suction manifold stud nuts, slide the suction manifold off the ends of the studs and lower the manifold to the floor with the straps and hoist. When reinstalling the suction manifold, tighten the retainer screws to the torque listed in the back of the manual and drive in new expansion plugs to the same depth in the bores as the removed plugs were located.

The replacement procedure for the discharge valves is similar to that used for the suction valves. However, since the discharge manifold must be lifted upward on the manifold studs, two threaded holes are built into the manifold to enable it to be lifted with the aid of a hoist. To replace the valves, remove the discharge manifold stud nuts, install two eye bolts in the threaded holes and lift the manifold with a hoist.

⚠ DANGER

Use only eye bolts which are in good condition, have a rated lifting capacity greater than the manifold being lifted and are installed to the full length of their threads into the manifold. Failure to follow this notice could allow the manifold to fall, which could cause equipment damage and/or serious personal injury or death.

After the discharge manifold has been lifted up, the discharge valves can be removed, inspected and replaced as necessary. Before replacing the valves, inspect the valve assemblies, manifold and cylinder surfaces and the valve gaskets to insure they are not scratched, nicked or otherwise damaged. Make sure the cage is tightened on the seat to the torque level listed in the back of the manual. Install the gaskets in the valve grooves and position the valves in the cylinder bores with the seat in the cylinder. Lower the discharge manifold onto the valve flanges while taking care the pilots on the valve flanges fit into the openings in the discharge manifold. Install the discharge manifold stud nuts and tighten them to the torque value listed in the back of the manual.

STUFFING BOXES – Stuffing boxes made from different materials and in several sizes can be matched with various fluid cylinders used on the pumps.

When servicing a stuffing box, plunger or packing, start by removing the plunger to extension rod coupling. Keep the coupling halves together as sets. Do not intermix halves.

⚠ WARNING

After removing the plunger to crosshead extension coupling, do not use a screwdriver or cold chisel to separate the extension and plunger flanges, as burrs may be formed which could cause misalignment on reassembly. Instead, rotate the eccentric slightly. If the parts do not separate, carefully slip a pipe wrench around the plunger neck and use a pulling and rotating motion to separate the plunger from the extension rod. Use caution to avoid damaging the plunger wear surface.

Continue to rotate the crankshaft to pull the extension rod away from the plunger as far as it will go. Remove the gland nut and the stuffing box stud nuts. Lift the stuffing box, plunger and packing assembly out through the cradle opening in the top of the pump frame. Lay the stuffing box assembly on a work bench and slide the plunger and packing out of the stuffing box.

When replacing the stuffing box, plunger and packing assembly, the above procedure is reversed. However, first inspect the stuffing box bore for scratches, wear or other defects. Clean and check the stuffing box face, gasket groove and outside diameter that pilots into the frame, to insure they are free of defects, burrs and dirt. Clean out any burrs, dirt and rust in the stuffing box pilot bores in the frame. Install the packing in the box. Place a new gasket in the stuffing box groove. The gasket chamfered edge must face out to prevent gasket pinching when the stuffing box and cylinder surfaces are pressed together.

Place the stuffing box assembly on the stuffing box studs. If the stuffing box does not enter the frame easily, do not hit the box with any type of hammer, as you may damage the box or dislodge the gasket from the groove. Instead, remove the box and recheck the frame bore for dirt or rust build–up and the stuffing box pilot for dirt or damage. Install and torque the stuffing box stud nuts to

the value listed in the back of the manual. Alternately tighten the nuts diagonally across from each other to insure the gasket is drawn up evenly. Install the gland bushing and gland on the box.

PLUNGERS – Plungers with Colmonoy, ceramic or tungsten carbide wear surfaces are normally used, depending on the service conditions. However, other materials can be supplied for special applications.

Before installing a new plunger, or reinstalling a used plunger, check for scratches, pits, nicks or a rough finish on the plunger wear surface. Inspect the mating pilots and ends of both the plunger and extension rod for burrs and dirt. Check to make sure the extension rod pilot knob is not broken or damaged. A broken knob could also be lodged in the plunger pilot hole. Replace any damaged parts. Burrs, other damage, or dirt between the plunger and extension rod ends and pilots can misalign a plunger and lead to early plunger and packing failure.

Use only Gardner Denver replacement plungers, as many other brands do not have the material quality or fine surface finish needed to provide long plunger and packing life.

A plunger, packing and stuffing box should be installed in the pump as an assembly (see "Stuffing Boxes," page 17). After this assembly has been completed, take the plunger coupling halves that had been kept as a matched set from the time of disassembly, and install the set using the fastener torque listed at the back of the manual. If one coupling half has been damaged, do not use a new half with a used half. Instead, use a complete new coupling set. Tighten the coupling evenly so the gap between halves is the same on both ends.

PLUNGER PACKING – The stuffing boxes are packed with nonadjustable lip type packing for low pressure, general service applications. Self adjusting packing in various lip styles and braided configurations is also offered for higher pressure and/or special service conditions. Lubrication is required for all lip style and most braided style packings. Packing lubricating oil types and required flow rates are discussed in "Packing Lubricator," page 19.

Before installing the packing, clean the stuffing box and check the bore for nicks, scratches and wear. A damaged box should be replaced to avoid early packing failure. Inspect all metal and/or plastic packing rings, spacers and bushings to insure they are clean and free of nicks and burrs. Always install new packing rings in complete sets. Coat all packing parts with light oil, DO NOT USE GREASE. Install the packing and components in the stuffing box in the same order as the parts were removed. When using lip style packing, be sure the lips of the sealing rings face the pressure (toward the fluid end). Coat the plunger with oil and slide it into the packing.

Install stuffing box, plunger and packing as an assembly on the fluid cylinder, using the procedure described in "Stuffing Boxes," page 17.

NOTICE

This procedure details that the gland should not be threaded on the stuffing box before the box is assembled on the fluid cylinder

This assembly sequence is recommended, since on most pump models the gland will interfere with the wrench and/or socket used to tighten the stuffing box retaining nuts, particularly nuts on the bottom side of the box.

When the nonadjustable packing is used, tighten the gland firmly with a 24 inch section of one half inch pipe placed over a lock pin, which has been inserted in a lock pin hole in the gland. When using self adjusting packing, tighten the gland nut firmly, after assembling it metal to metal with the stuffing box. Do not overtighten the nut, as the threads or lock pin holes could be damaged.

⚠ DANGER

Regardless of the packing used, the gland must be engaged by at least (3) threads to hold the pump discharge pressure. An improperly tighten gland could cause personal injury, death and/or equipment damage. This can occur either through direct contact with the pressurized flow or by contact with objects the fluid stream propels.

⚠ DANGER

Do not attempt to adjust packing while pump is in operation to avoid personal injury or death from moving parts.

When using the nonadjustable packing, operate the pump for two (2) or three (3) hours under pressure, stop the pump, relieve the pressure and retighten the glands to prevent packing movement.

Regardless of the style packing used, keep lock pins in place to prevent the glands from backing loose.

Several other types of packing may be used in standard stuffing boxes. Installation procedures for other packing may vary from the above. Additional information can be obtained by contacting Gardner Denver Machinery Inc. Customer Service.

PACKING LUBRICATOR – A force feed plunger packing lubricator is required for most packings and is available as optional equipment for all models. The lubricator is mounted on a bracket over the frame and is driven by a V–belt drive off the crankshaft extension. Oil is delivered to the tapped opening in each stuffing box through steel tubing. The lubricator is equipped with a check valve at each stuffing box connection.

Use rock drill oil for normal conditions and steam cylinder oil for high temperature fluids. Select an oil with the proper pour point for the ambient temperature. Some acceptable oils are listed in the chart on page 25.

Initially set the lubricator to deliver eight (8) to ten (10) drops of oil per minute to each stuffing box. More flow may be required for large plungers and/or high speeds, pressures or pumped fluid temperatures. Less flow may be needed for small plungers and/or low speeds or pressures. Flow can be controlled by backing off the jamb nut that locks each plunger body in position on the lubricator and rotating the plunger body. Rotate the plunger clockwise to increase flow and counter clockwise to decrease flow. Lock the jamb nuts down again after making an adjustment. Increase the flow if the packing starts to heat up.

CRANKSHAFT – The crankshaft has an extension on both ends to enable the pump to be driven from either side. A packing lubricator can be driven off the extension not used to drive the pump. The crankshaft is equipped with paddles to throw oil up into the crosshead and connecting rod oil reservoirs. The pump models covered by this manual are designed to run at low enough speeds so that crankshaft counterweights are not required for smooth operation.

All crankshafts covered by this manual are supported by tapered roller outer main bearings. The bearing cups remain in the bearing end plates when the plates are removed. Quintuplex pumps also have a straight roller bearing supporting the center portion of the crankshaft. The inner race of the center main bearing is held on the crankshaft with a shrink fit. A retainer ring positioned in a groove cut in the crankshaft is used as a retention back–up.

When removing the crankshaft, start by removing the plungers or extension rods, plus the oil stop head. Drain the oil from the crankcase and then remove the drive sheave, the frame end plate, connecting rod nuts and caps and both main bearing end plates. Make sure the rods and caps which were paired in the removed assemblies are kept together for proper reassembly.

⚠ WARNING

The crankshaft must be supported when removing and installing the crankshaft end plates to avoid damaging the bearings.

End clearance for the outer main bearings is adjusted by adding or removing different thicknesses of color coded gasket shims between the frame and both crankshaft end plates. Clearance on the quintuplex pump center main bearing is not adjustable.

When removing the crankshaft end plates, write down the number and color of end plate gasket shims removed and the side of the pump they were removed from. When the end plates are reassembled, install the same number and color of shims as were removed from the respective sides of the pump. Push the connecting rods and crossheads toward the fluid end far enough to clear the crankshaft. The triplex pump crankshafts covered by this manual are reversible end–for–end, while quintuplex crankshafts are not. However, unless the main tapered roller bearings are replaced, mark the triplex pump crankshaft orientation, so the original tapered roller bearing assemblies are reunited. The tapered roller bearing cups remain in the crankshaft end plates as the plates are removed from the frame. The straight roller bearing outer race on quintuplex pumps also stays in the frame as the crankshaft is removed.

Using a rope sling for support, remove the crankshaft, bearing inner races and/or cones with rollers, as an assembly from either side of the pump. If the roller bearings are to be replaced, remove the wear sleeves from both ends of the crankshaft, as the inner bearing races will not pass over the wear sleeves. Cut the roller cages off, heat the cones and pull them off the shaft ends. The center main inner race on quintuplex pumps is removed using the same procedure as is used on the outer bearings, except the retainer ring is removed before the cage is cut off.

The roller bearing cups can be removed from the bearing end plates by laying a heavy bead of weld around the inside of the cup, being careful not to run the weld onto the bearing end plate. When the cup cools, it will normally fall out of the end plate. The center main bearing outer race on quintuplex pumps is removed by unscrewing the two set screws at the back of the frame, pushing the bearing retainer lock pins out of the way and sliding the outer race out of the frame bore.

The crankshaft journals are ground and polished to insure long connecting rod bearing life. Large fillet radii are ground into the crankshaft to provide superior strength. The crankshafts in some models are also heat treated for additional strength and wear resistance. Before installing a crankshaft, inspect all bearing surfaces, fillet radii and wear sleeves for nicks, scratches or other distress. Inspect the main bearing outer and inner races and/or cups and cones, rollers for wear and damage. Replace the crankshaft, main bearings and wear sleeves if damage is found. Wipe all parts clean before assembly.

When installing a new roller bearing cone on a crankshaft extension, start by heating the cone and roller assembly to a maximum of 300°F (if the bearing turns blue when heated, it has gotten too hot and should not be used). While wearing heavy, insulated gloves, pick up the cone and position the wide side of the cone toward the crankshaft extension. Quickly slide cone onto the extension until the wide side of the cone is firmly positioned against the extension shoulder before the cone cools enough to seize on the crankshaft.

The inner race on a quintuplex pump center bearing can be installed by sliding the race onto the crankshaft turned diameter until the race contacts the machined shoulder and placing the retaining ring in the ring groove.

To install the crankshaft, reverse the crankshaft removal procedure described above. However, before installing the crankshaft, make sure the crosshead and connecting rod assemblies do not first have to be removed and/or installed through the frame end plate opening.

When installing a bearing cup in a bearing end plate, wipe all parts clean, inspect for damage and if none is found, drive the cup into the end plate with a rubber hammer. To insure proper lubrication, both main bearing end plates must be installed with their cast–in oil trough located above the bearing. This positioning will occur when the end plates are assembled on the frame with the word “TOP” (cast on the plate outer surface) in the uppermost position.

The end clearance for both main bearings is adjusted by the use of plastic shim gaskets between the frame and the bearing end plates. Install each bearing end plate over its crankshaft extension, using the same number and color of new shim gaskets you recorded were found on that side of the pump when the crankshaft was removed. Thread all the end plate retaining screws through the plates and into the frame. Torque the end plate screws evenly to the torque listed in the back of the manual. Using a pry bar placed against a crankshaft paddle and pivoted on a side of the frame end plate opening, firmly push the crankshaft to one side. Place a dial indicator on the end of one crankshaft extension and firmly pry the crankshaft back in the opposite direction. Note the dial indicator reading and pry the crankshaft back in the original direction. Read the dial indicator again to confirm it has returned to the original setting. Compare the dial indicator movement, which is the actual main bearing clearance, to the bearing clearance listed in the back of the manual. Add or subtract shim gaskets as required to achieve the required clearance, if the dial indicator readings do not fall within the required range. Split the shim pack to equalize gasket thickness on both sides.

After installing the bearing end plates place a new seal wear sleeve on each crankshaft extension. An installation tool should be used to insure the sleeve is started squarely on the shaft and is not damaged while being driven into position. Be sure to locate the new sleeve in the same exact position as the old sleeve. Install new oil seals in both bearing end plates, using a .010 inch feeler gauge to roll the lip onto the wear sleeve.

CROSSHEADS AND CONNECTING RODS – The crossheads and connecting rods are lubricated with oil thrown into the reservoirs cast in the frame and connecting rods. Oil holes in these parts direct oil to the crosshead bushings and connecting rod bearings. To insure an adequate supply of oil is thrown into the reservoirs by the crankshaft paddles, the pumps covered by this manual must not be run below the minimum speeds listed by model on pages 35 thru 60.

The crosshead and connecting rod assembly can be removed through the oil stop head on TDE, TAE, QBX, TDD and TQC pump models. Begin removal by disconnecting the plunger coupling and taking out the rubber splash baffle. Remove the stuffing box, plunger and

packing as an assembly, using the procedure listed in "Stuffing Boxes," page 17. TFE, TDE, TAE, QBX, TDD and TQC pumps have removable extension rods, which thread into their crossheads. These extension rods can be removed and installed by positioning a pipe wrench over the knurled section of the rod to loosen or tighten it in the crosshead. Early model TFE, TDE and TAE pumps had set screws in the crossheads that tighten against the threaded extension rods. Threaded rods with set screws cannot be unscrewed until the oil stop head covers are removed and the set screws backed–out. Threaded extension rods without set screws can be removed and installed while the crossheads remain in place. If in doubt as to whether set screws are used, remove the oil stop head before attempting to unscrew the extension rod and check for the presence of a set screw in the crosshead. All other model pumps have integral crossheads and extension rods.

After the oil stop heads have been taken out, remove the frame end plate and the connecting rod bolt nuts and cap. Be sure the original rod and cap pairs are identified, so they stay together for reinstallation. The rods and caps are machined together in matching assemblies at the factory. Identical numbers are normally stamped into adjacent edges of a rod and cap near the split line. Different numbers are used for different rod/cap pairs. Proper matching will occur when identical stamped rod and cap numbers are located on the same edge of the rod/cap assembly.

If the rod/cap stamped numbers are not visible, use a marker to identify the rod/cap pairs as you disassemble them. After the connecting rod caps have been removed, slide the crosshead and connecting rod assemblies out through the oil stop head openings.

On the TFE, TDD, TQW, TQB and TAC pump models, the crosshead and connecting rod assembly must be removed through the frame end plate opening. Follow the same disassembly procedures as described above for the pumps where the crosshead is removed through the oil stop head. However, after the connecting rod caps are removed, take out the crankshaft, following the procedure described in "Crankshaft," page 19. Then slide the crosshead and connecting rod assembly out through the frame end plate.

The crosshead pin is held in the connecting rod by a clamp screw on the TFE, TDE and TAE models. This screw must be removed before the crosshead and connecting rod assembly can be separated. The crosshead pin is pressed into the connecting rod on all other pump models covered by this manual. Remove and reinstall all pressed–in pins with a press. DO NOT HAMMER a pin in or out.

Before installing a crosshead, check the crosshead bore in the frame, the crosshead outside diameter, the extension rod (if it is integral with the crosshead) and the bushings for wear (see clearances in the back of the manual), nicks and scratches. Replace any damaged parts.

If new bushings are to be installed in the crossheads, note the location of the bushing in each bore and carefully press the old bushings out. DO NOT HAMMER the bushings in or out. Take care to protect the surface of the crosshead from damage while pressing the bushings. Make sure the bushings and bushing bores in the crossheads are in good condition. On pump models which have diagonal oil grooves cut into the inside diameter of the bushings, make sure the grooves are located nearest the extension rod end of the crosshead. This position is necessary to provide adequate pin/bushing lubrication. Align the oil hole in the bushing with the oil feed hole in the crosshead and press the new bushing into the crosshead bore, to the same location you noted the old bushing had been installed. Check to insure this positioning locates the bushing far enough into the crosshead to prevent the bushing outside edges from rubbing on the crosshead bore in the frame, but not so far into the bore as to bind on the connecting rod. Also check to insure the oil holes in the bushings line up with the oil feed holes in the crosshead. If the oil holes are badly aligned after installation, press the bushings out and reinstall them. If there is any misalignment of the bushing and crosshead holes, run a drill sized to the full hole diameter down the crosshead oil hole and just through the bushing wall. This will provide full oil flow to the bushings. Hone the bushings to a 5 to 30 microfinish. See pages 35 thru 61.

Before installing a crosshead pin in a connecting rod, inspect the pin and rod bore for nicks, scratches and wear. Measure the pin and the rod small end bore vs. the acceptable sizes listed in the back of the manual. Replace any worn or damaged parts. Make sure the connecting rod and cap oil reservoirs/holes and the crosshead oil grooves/holes are assembled so they will all face upward when installed in the pump. All pins, whether clamped or pressed–in, must be centered in the crosshead and connecting rod assembly, to insure the two bushings in the crosshead are evenly loaded. On the pump models with a crosshead pin clamp screw, refer to the torque specification in the back of the manual to insure the screw is properly tightened. On models with pressed–in pins, coat the pin with oil before pressing it in.

Crankpin bearings are steel backed, babbitt lined, precision type. The bearing halves can be easily removed from the connecting rod by rotating them out, after the connecting rod cap has been removed.

Before installing the connecting rods and new bearings in the pump, check the new bearings to insure they are not nicked or scratched. Also check the connecting rod/cap bores for nicks, scratches and wear. Replace any worn or damaged parts.

Pair the identically numbered rods and caps and assemble them without the bearings, using the torque value listed by model for the rod bolt nuts on pages 37 thru 63.

Measure the rod/cap bores and the crankpin journal diameters and compare these readings vs. the acceptable dimensions listed in the back of the manual. Replace any parts that do not fall within the acceptable size ranges.

Disassemble the rods and caps that have acceptable bore sizes and carefully wipe the bores to insure no dirt or oil is left on these surfaces. Wipe the bearing insert backs also. Trapped dirt between the bearings and bores will cause a high spot and rapid bearing wear. Trapped oil could prevent full bearing to bore contact and cause the bearing to overheat. Be sure the projecting tab on each bearing fits into the corresponding groove in the rod and cap. Both inserts, comprising a full bearing, are identical.

⚠ WARNING

The oil holes in the bearing halves must line up completely with the oil holes drilled in the connecting rod and cap to provide adequate bearing lubrication.

Just before assembling the connecting rod and cap, snap the bearing halves into their respective bores. Apply several drops of oil to each half and spread it over the bearing surface with a clean finger. This oil will lubricate the bearings at initial start–up, before the connecting rod and cap splash oil reservoirs fill.

Just before installation in the pump, lay the crosshead and connecting rod assembly on a work bench with the crosshead oil holes facing up. Fill the crosshead oil holes with GL–5 oil. While holding the crosshead, move the connecting rod up and down and side to side to distribute the oil over the crosshead bushings. Smear a quantity of the same oil on the crosshead outside diameter. The oil will lubricate the crosshead and bushings at initial start–up, before the crosshead oil reservoir fills.

⚠ WARNING

All oil holes, which are drilled in the connecting rod and cap oil reservoirs and in the crosshead oil grooves, must be facing up to provide adequate lubrication.

Install the connecting rods and crossheads as assemblies, either through the oil stop head openings or the frame end plate opening, depending on the pump model. Be sure to once again match each cap with the correct connecting rod.

Before installing the nuts on the connecting rod cap bolts, reach in and feel to make sure the flat on the bolt head is seated against the flat relief on the connecting rod. This must be done to prevent the bolt from riding up the side of the rod. Finally, install the nuts and torque them to the value listed on pages 37 thru 63.

The oil stop heads are attached to the pump frame with either screws or T–bolts. The T–bolts turn against cast–in stops on the inside of the oil stop heads and catch the inside lip of the frame opening. When reinstalling an oil stop head, check both the gasket and extension rod seals for wear or damage. Replace any gaskets or seals that are not in good condition. Also, replace these parts at any time they are found to be leaking.

Before installing a threaded extension rod, check it for wear, scratches or other damage. Replace any rod that is not in good condition. Apply a coating of GL–5 oil to the rod, regardless of whether it threads into, or is integral with a crosshead, before the oil stop head packing is slipped over the rod. Tighten a threaded rod to the torque specified at the back of the manual, using a pipe wrench positioned over the knurled section of the rod.

Slip a rubber baffle over the end of the extension rod and position it next to the plunger coupling groove, before installing the plunger coupling. Check to insure that the baffle fits tightly on the extension rod. Discard any used baffle that is damaged or has become too flexible to maintain its shape while the pump is operating. The baffle is designed to help prevent pumped fluid, which may spray or leak past worn plunger packing, from entering the crankcase through the oil stop head packing.

⚠ WARNING

Failure to properly install and maintain the baffles voids the warranty, as the crankcase can be damaged by pumped fluid entry.

Inspect the plunger coupling and fasteners. Replace any of these parts found to be worn or damaged. Tighten the plunger coupling fasteners to the torque listed at the back of the manual. Take care to keep the gap between the coupling halves as even as possible on both ends. Replace both coupling halves with a new set if the halves come together and do not have a gap when tightened. Do not shim the old parts to achieve a gap. Check the coupling fasteners frequently for proper torque.

⚠ WARNING

Failure to properly install and maintain the plunger couplings can lead to serious pump damage caused by plunger misalignment and hammering.

Make sure the drain in the cradle and any piping connected to the drain is not blocked. If pumped fluid escaping past worn packing builds up in the cradle, it may enter and damage the power end by splashing against the oil stop head packing.

CRANKCASE OIL REQUIREMENTS

API–GL5 Oil Grade	Ambient Temperature	Crankcase Operating Oil Temperature *	Minimum Startup Oil Temperature
75W–90	–20° F to 60° F (–29° C to 16° C)	60° F to 140° F (16° C to 60° C)	20° F (–7° C)
80W–140	10° F to 100° F (–12° C to 38° C)	90° F to 180° F (32° C to 82° C)	50° F (10° C)
80	–10° F to 45° F (–23° C to 7° C)	70° F to 125° F (21° C to 52° C)	30° F (–1° C)
90	20 F to 80° F (–7° C to 27° C)	100° F to 160° F (38° C to 71° C)	60° F (16° C)
140	50 F to 115° F (10° C to 46° C)	130° F to 195° F (54° C to 90° C)	80° F (27° C)

* An 80° F (27° C) crankcase oil temperature rise over ambient air temperature is typical for the pumps covered by this manual when operating at or near rated horsepower.

Oil viscosity must not exceed 7000 SSU at start–up and must be between 1500 SSU and 200 SSU while operating, regardless of the oil temperature or grade used. A crankcase heater and/or an oil heat exchanger may be needed to meet these requirements.

⚠ WARNING

Failure to follow these lubrication requirements will void the warranty.

PLUNGER PACKING
LUBRICATION RECOMMENDATION CHART

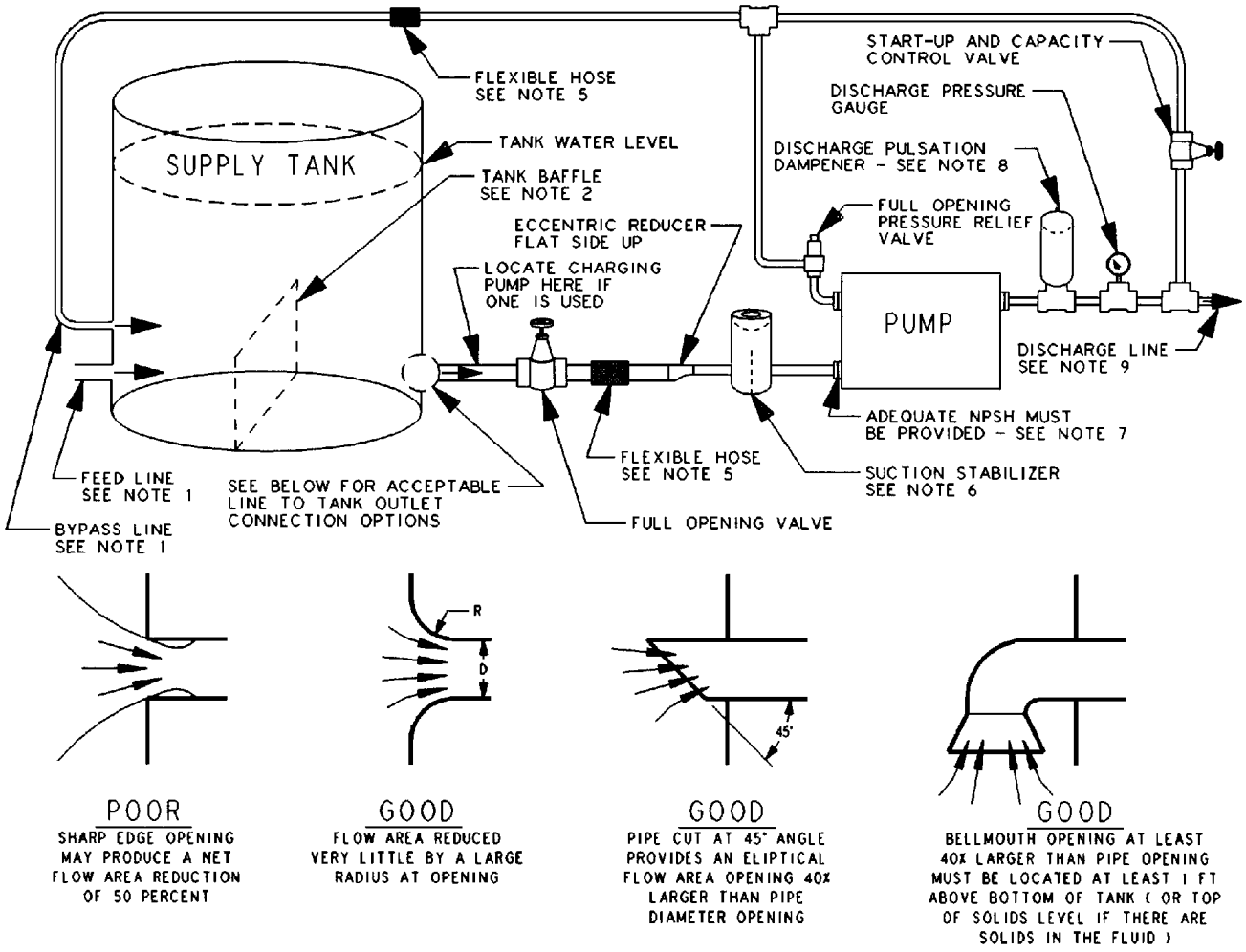
ROCK DRILL LUBRICANTS

Source	Type	Pour Point Maximum
Amoco	Amoco Rock Drill Oil – Light	–20°
	Amoco Rock Drill Oil – Medium	0°
Arco	Air Drill #147	0°
	Arco Trueslide #150	15°
Chevron Oil U.S.A.	Vistac #68X	10°
	Vistac #100X	5°
	Vistac #150X	0°
Conoco	EP Rockdrill #49, #17, #78	5°
Gulf Oil (Chevron)	Rockdrill #100	–30°
	Rockdrill #32	–35°
Exxon	Arox EP #46	–20°
	Arox #150	–35°
Mobil Oil Co.	Alamo #525	–10°
	Alamo #527	–25°
	Alamo #529	–10°
	Alamo #532	0°
Pacer Oil	Rockdrill #150	–10°
	Rockdrill #600	0°
Phillips Petroleum	EP #500 (Summer) or EP #300 (Winter)	–10°
Shell Oil Co.	Torcula Oil #32	–50°
	Torcula Oil #100	–20°
	Torcula Oil #150	–15°
	Torcula Oil #320	–10°
Sun Oil Co.	Rockdrill 500 (Light)	5°
	Rockdrill 1000 (Heavy)	5°
Texaco Oil Co.	Rockdrill Oil XL	–40°
	Rockdrill Oil XM	0°
	Rockdrill Oil XH	–20°
Union Oil of Ca.	Marok 150	——

STEAM CYLINDER OILS

Source	Type
Amoco	Amoco Cylinder Oil 460
Arco	Modco Cylinder Oil 125, 175
Conoco	Inca Cylinder Oil
Exxon	Cylesstic TK–460 or TK–1000
Gulf Oil (Chevron)	Senate #375 Compound
	Security #460 Non–Compound
Mobil Oil Co.	Mobil Cylinder Oil 600W
Pacer Oil	Com–Cyl Oil
Phillips Petroleum	Hector Cylinder Oil
Shell Oil Co.	Valvata J–460
Sun Oil Co.	Occident
	Gear Oil 7–X, Gear Oil 8–C
Texaco Oil Co.	Pinnacle Cylinder Oil

GARDNER DENVER HORIZONTAL PUMP
RECOMMENDED SYSTEM LAYOUT FOR PROPER PERFORMANCE



NOTES:

1) Feed line and bypass line openings in tank must be located below the top of baffle and on opposite side of tank from outlet opening.

2) The baffle must be completely submerged at minimum liquid level in the tank. The baffle must be placed between the feed line and tank outlet to pump and should extend from one side of the tank to the other.

3) If a tank baffle cannot be installed, flow into the tank must be directed away from tank outlet to pump so entrained gasses do not flow directly into tank outlet.

4) A short straight suction line is preferred from the tank to the pump. If this is not possible, use as few bends as possible and use long radius elbows. The smallest portion of the line should be at least as large as the pump suction opening. Flow velocity should be 3 ft/sec or less.

5) Suction and discharge lines should each contain a section of flexible hose to remove piping strain and vibration.

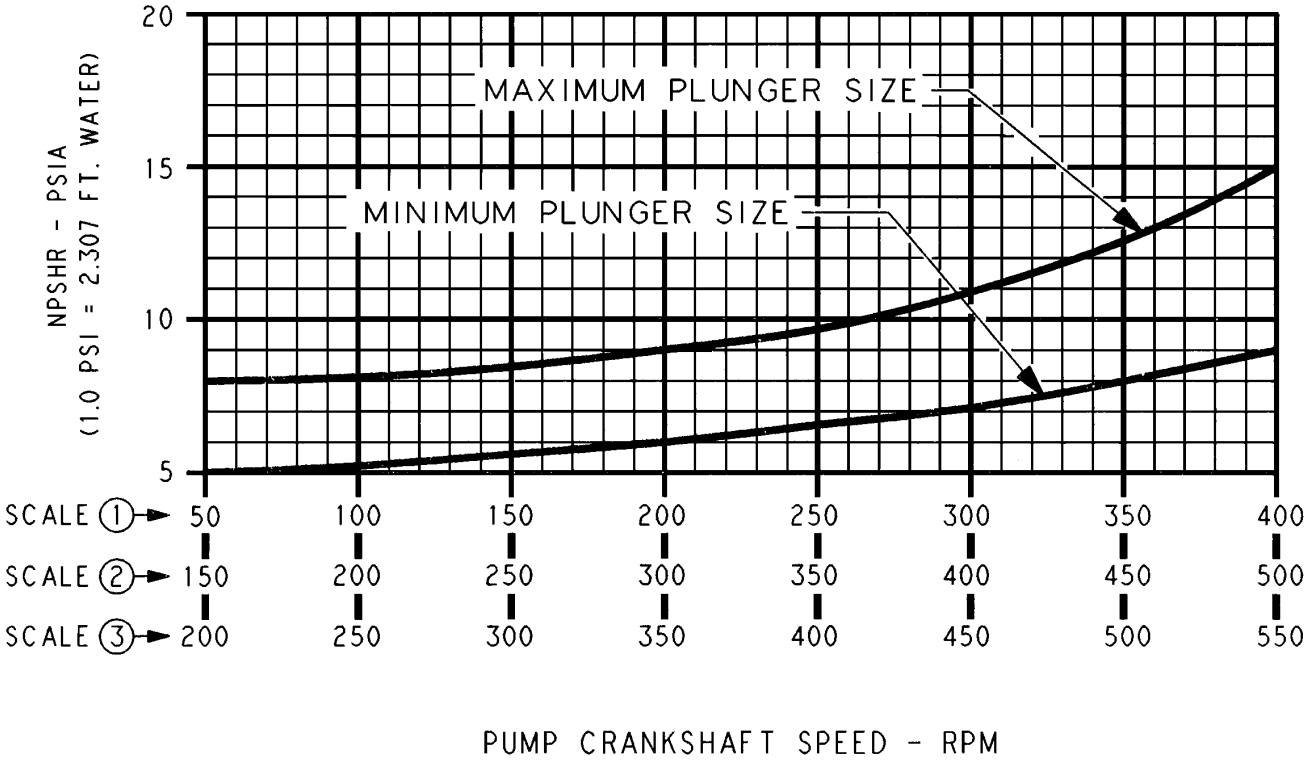
6) The suction stabilizer should be a bladder type with an internal baffle between the inlet and outlet connections.

7) NPSH provided by suction system must be adequate to satisfy pump requirements. Refer to NPSHR curve or consult Gardner–Denver Marketing.

8) A bladder type discharge pulsation dampener is recommended.

9) Discharge line flow velocity should be 10 ft/sec or less.

NET POSITIVE SUCTION HEAD REQUIRED (NPSHR)
AT FLUID CYLINDER SUCTION CONNECTION WITH SUCTION STABILIZER
AND DISCHARGE PULSATION DAMPENER INSTALLED



- Use scale (1) for models: TQC, TDD, TAE, TDE & TFE (LP & MP Aluminum Bronze)
- Use scale (2) for models: TAC & QBX
- Use scale (3) for models: TQB & TQW

Pump Bulletins list maximum and minimum plunger sizes. Interpolate between NPSH curves for each plunger size.

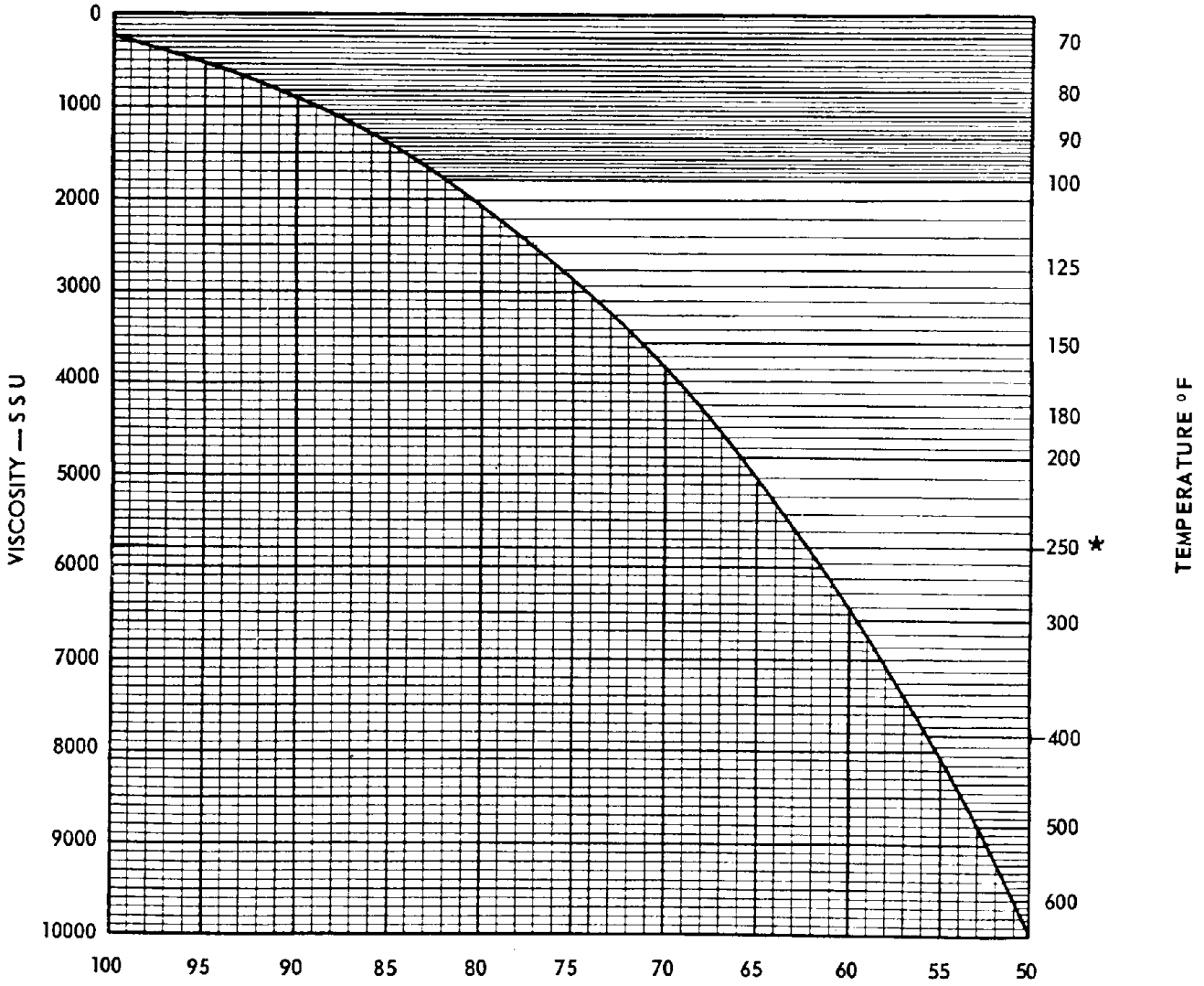
1) NPSHR is defined at a 3% flow drop below maximum capacity, caused by beginning cavitation.

2) These curves were generated from data recorded on test pumps using new plungers and packing. Pumps in service will normally require NPSHR values above atmospheric pressure to avoid cavitation caused by air being drawn into the cylinder past worn plungers and packing.

3) Added suction head above that shown by the curves must also be provided for the higher vapor pressure of warmer water (curves are based on 60°F water) and/or other fluids, for gasses disolved in the pumped fluid (ex. air in water), and for acceleration head and friction losses in systems having long and/or restricted suction lines. Therefore, installed pump NPSHR will vary widely between applications of the same pump.

4) In summary, experience has shown that for most service applications, the user is well advised to design the pump suction system to provide: a minimum 4.3 PSIG (10 ft. of water) at the pump inlet connection to minimize problem cavitation.

CORRECTION CHART FOR TEMPERATURE OR VISCOSITY



* Maximum allowable on Triplex and Quintuplex Models

VISCOSITY CONVERSION TABLE

This table lists a comparison of various viscosity ratings, when the viscosity is given in terms other than Saybolt Universal, it can be translated by following horizontally to the Saybolt column.

Seconds Saybolt Universal ssu	Kinematic Viscosity Centistokes *	Seconds Saybolt Furol ssf	Seconds Redwood 1 (Standard)	Seconds Redwood 2 (Admiralty)	Degrees Engler	Degrees Barbey	Seconds Parlin Cup #7	Seconds Parlin Cup #10	Seconds Parlin Cup #15	Seconds Parlin Cup #20	Seconds Ford Cup #3	Seconds Ford Cup #4
31	1.00	—	29	—	1.00	6200	—	—	—	—	—	—
31	1.00	—	29	—	1.00	6200	—	—	—	—	—	—
35	2.56	—	32.1	—	1.16	2420	—	—	—	—	—	—
40	4.30	—	36.2	5.10	1.31	1440	—	—	—	—	—	—
50	7.40	—	44.3	5.83	1.58	838	—	—	—	—	—	—
60	10.3	—	52.3	6.77	1.88	618	—	—	—	—	—	—
70	13.1	12.95	60.9	7.60	2.17	483	—	—	—	—	—	—
80	15.7	13.70	69.2	8.44	2.45	404	—	—	—	—	—	—
90	18.2	14.44	77.6	9.30	2.73	348	—	—	—	—	—	—
100	20.6	15.24	85.6	10.12	3.02	307	—	—	—	—	—	—
150	32.1	19.30	128	14.48	4.48	195	—	—	—	—	—	—
200	43.2	23.5	170	18.90	5.92	144	40	—	—	—	—	—
250	54.0	28.0	212	23.45	7.35	114	46	—	—	—	—	—
300	65.0	32.5	254	28.0	8.79	95	52.5	15	6.0	3.0	30	20
400	87.60	41.9	338	37.1	11.70	70.8	66	21	7.2	3.2	42	28
500	110.0	51.6	423	46.2	14.60	56.4	79	25	7.8	3.4	50	34
600	132	61.4	508	55.4	17.50	47.0	92	30	8.5	3.6	58	40
700	154	71.1	592	64.6	20.45	40.3	106	35	9.0	3.9	67	45
800	176	81.0	677	73.8	23.35	35.2	120	39	9.8	4.1	74	50
900	198	91.0	762	83.0	26.30	31.3	135	41	10.7	4.3	82	57
1000	220	100.7	896	92.1	29.20	28.2	149	43	11.5	4.5	90	62
1500	330	150	1270	138.2	43.80	18.7	—	65	15.2	6.3	132	90
2000	440	200	1690	184.2	58.40	14.1	—	86	19.5	7.5	172	118
2500	550	250	2120	230	73.0	11.3	—	108	24	9	218	147
3000	660	300	2540	276	87.60	9.4	—	129	28.5	11	258	172
4000	880	400	3380	368	117.0	7.05	—	172	37	14	337	230
5000	1100	500	4230	461	146	5.64	—	215	47	18	425	290
6000	1320	600	5080	553	175	4.70	—	258	57	22	520	350
7000	1540	700	5920	645	204.5	4.03	—	300	67	25	600	410
8000	1760	800	6770	737	233.5	3.52	—	344	76	29	680	465
9000	1980	900	7620	829	263	3.13	—	387	86	32	780	520
10000	2200	1000	8460	921	292	2.82	—	430	96	35	850	575
15000	3320	1500	13700	—	438	2.50	—	650	147	53	1280	860
20000	4400	2000	18400	—	584	1.40	—	860	203	70	1715	1150

* Kinematic Viscosity (in centistokes) = $\frac{\text{Absolute viscosity (in centipoises)}}{\text{Specific Gravity}}$

Above 250 SSU, use the following approximate conversion:

SSU = Centistokes x 4.62

Above the range of this table and within the range of the viscosimeter, multiply their rating by the following factors to convert to SSU:

Viscosimeter	Factor	Viscosimeter	Factor
Saybolt Furol	10.	Parlin cup #15	98.2
Redwood Standard	1.095	Parlin cup #20	187.0
Redwood Admiralty	10.87	Ford cup #4	17.4
Engler – Degrees	34.5		

SECTION 4
TROUBLE–SHOOTING

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Pump Overloads Driver.	1. Excessive pump speed and/or discharge pressure.	1. Reduce pump speed and/or pressure.
	2. Blockage or closed valve in discharge line.	2. Clean or open valve.
	3. Incorrect plunger size.	3. Install the correct plunger.
	4. Improper bypass conditions.	4. See recommended system layout, and correct error.
Fluid Not Delivered.	1. Pump not primed.	1. Prime pump.
	2. Air or vapor pocket in suction line.	2. Remove pocket from line.
	3. Clogged suction line.	3. Clean out line.
	4. Suction and/or discharge valves propped open.	4. Remove prop.
Low Discharge Pressure.	1. Worn or fluid cut valve assembly.	1. Replace valve assembly.
	2. Valve propped open.	2. Remove prop.
	3. Pump cavitating.	3. See Cavitation, Fluid Knock or Hammer problem.
	4. Fluid leakage.	4. Replace plungers/packing and/or fluid end seals.
	5. Erroneous gauge reading.	5. Recalibrate or replace gauge(s).
Low Suction Pressure.	1. Low head (NPSH).	1. Raise fluid supply level. Install charging pump.
	2. Insufficient charging pump capacity.	2. Increase charging pump speed or size.
	3. Retarded fluid flow.	3. Remove restrictions from suction line.
	4. Erroneous gauge reading.	4. Recalibrate or replace gauge(s).
Cavitation, Fluid Knock or Hammer.	1. Improper suction system layout.	1. See recommended system layout in manual.
	2. Low suction pressure.	2. See Low Suction Pressure problem.
	3. Suction stabilizer and pulsation dampener not used.	3. Install suction stabilizer and pulsation dampener.
	4. Defective stabilizer or dampener.	4. Repair and recharge or replace.

PROBLEM		POSSIBLE CAUSE		SUGGESTED ACTION
Cavitation, Fluid Knock or Hammer (continued).	5.	High fluid temperature or viscosity.	5.	Reduce pump speed per chart in manual.
	6.	High fluid vapor pressure.	6.	Increase NPSH.
	7.	High acceleration head.	7.	Increase supply line size. Decrease supply line length.
	8.	Suction valve spring too stiff with low NPSH.	8.	Use more flexible spring. Remove inner spring from two spring valve.
	9.	Air/Gas in pumped fluid.	9.	Allow more settling time in supply tank. Reduce pump speed.
	10.	Air entering suction line.	10.	Repair suction line.
	11.	Air entering charging pump.	11.	Tighten or replace shaft packing or seal.
	12.	Air entering or charge gas escaping from suction stabilizer.	12.	Repair and recharge stabilizer.
	13.	Multiple pumps operating in phase.	13.	Use a suction stabilizer on each pump. Separate lines may also be needed.
Suction or Discharge Line Vibration.	1.	Line(s) not supported.	1.	Install supports or hangers.
	2.	Pump cavitating.	2.	See Cavitation, Fluid Knock or Hammer problem.
High Crankcase Oil Temperature.	1.	High ambient temperature.	1.	Use an oil heat exchanger with a circulating pump.
	2.	Improper type/grade oil used.	2.	Use recommended oil.
	3.	Pump overloaded.	3.	Reduce pump speed and/or pressure.
	4.	Improper clearance in main or rod bearings, crossheads or bushings.	4.	Check and adjust clearance. Replace parts as required.
Knock In Power End.	1.	Improper main bearing clearance.	1.	Check and adjust clearances.
	2.	Incorrect pump rotation.	2.	Reverse rotation.
	3.	Loose plunger coupling.	3.	Check and tighten. Replace if damaged.
	4.	Loose extension rod.	4.	Check and tighten. Replace if damaged.
	5.	Loose connecting rod cap.	5.	Check and tighten. Replace if damaged.
	6.	Loose bearing housings/covers.	6.	Check and tighten. Replace if damaged.
	7.	Worn crosshead pin.	7.	Replace.

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Knock In Power End (continued).	8. Worn crosshead pin bushing.	8. Replace.
	9. Worn connecting rod to eccentric bearing.	9. Replace.
	10. Worn crankshaft.	10. Replace.
	11. Worn crosshead.	11. Replace.
	12. Worn main bearing.	12. Replace.
	13. Valve noise transmitted to power end.	13. See Excessive Valve Noise problem.
	14. Cavitation noise transmitted to, or causing shock loading in, power end.	14. See Cavitation, Fluid Knock or Hammer problem
Excessive Valve Noise.	1. Pump cavitation.	1. See Cavitation, Fluid Knock or Hammer problem.
	2. Seal on inserted valve damaged or missing.	2. Replaced seal or valve.
	3. Broken or weak valve spring(s).	3. Replace spring(s).
Oil Leakage From Stop Head.	1. Worn, damaged or corroded extension rod.	1. Replace extension rod.
	2. Worn oil stop head packing.	2. Replace packing.
	3. Oil level too high in crankcase.	3. Reduce oil level.
	4. Excessive crosshead wear.	4. Replace crosshead.
	5. Pressure in crankcase.	5. Clean or replace air breather.
Oil Seal Leakage.	1. Worn sealing lip.	1. Replace seal.
	2. Damaged sealing lip.	2. Replace seal.
	3. O.D. not seated.	3. Clean and polish bore of oil seal housing.
	4. Shaft rough at seal lip.	4. Clean and polish shaft or replace wear sleeve.
	5. Pressure in crankcase.	5. Clean or replace air breather.
Stuffing Box Leakage.	1. Short plunger/packing life.	1. See Short Plunger/Packing Life problem.
	2. Worn packing rings/metal.	2. Replace packing rings/metal.
	3. Gasket leaking at fluid cylinder.	3. Check gasket, stuffing box groove and cylinder sealing surface.
	4. Corrosion due to wrong stuffing box material for pumped fluid.	4. Determine and install correct stuffing box.

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Pumped Fluid In Crankcase.	1. Worn, damaged or corroded extension rod.	1. Replace extension rod.
	2. Worn oil stop head packing.	2. Replace packing.
	3. Stuffing box leakage.	3. See Stuffing Box Leakage problem.
	4. Extension rod baffles damaged/ missing.	4. Install new baffles.
Short Valve Life.	1. Abrasives in pumped fluid.	1. Filter pumped product. Use severe duty valves with insert.
	2. Valve not sealing.	2. Broken valve spring – replace. Worn valve guide – replace. Worn valve/seat – replace.
	3. Pump cavitating.	3. See Cavitation, Fluid Knock or Hammer problem.
	4. Corrosion.	4. Treat pumped fluid. Use different materials for valves/seats. Install sacrificial anodes in suction manifold.
Short Plunger/Packing Life.	1. Abrasives in pumped fluid.	1. Consult GD Customer Service for plunger/ packing recommendation. Filter pumped fluid.
	2. Excessive plunger/packing friction.	2. Lubricate with rock drill oil. Do not overtighten adjust–able packing. Use Gardner Denver plungers.
	3. Metal parts or particles wearing plunger.	3. Check stuffing box alignment. Check gland alignment. Check plunger alignment. Check packing for foreign particles. Replace gland bushing. Replace lantern ring.
	4. Wrong plunger/packing for pumping conditions.	4. Consult GD Customer Service.
	5. Wrong size packing.	5. Install correct size packing.
	6. Improper packing installation.	6. Check installation procedure and install correctly.
	7. Excessive crosshead wear.	7. Replace crosshead.
	8. Pump cavitating.	8. See Cavitation, Fluid Knock or Hammer problem.

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Catastrophic Failures Such As Broken Shafts, Bent Rods, etc.	1. Pump overloaded.	1. Reduce pump speed and/or pressure.
	2. Start–up against closed discharge valve.	2. Insure valve is open before starting.
	3. Main bearing failure.	3. Repair or replace.
	4. Plunger striking valve or valve parts.	4. Check valve condition and installation procedure.
	5. Plunger striking cylinder.	5. Check plunger for proper length.
	6. Frozen fluid in cylinder.	6. Do not start pump when pumped fluid is below freezing temperature.
	7. Low oil level in sump.	7. Check oil level frequently, and add oil as required.
	8. Contaminated oil in sump.	8. Check oil condition frequently.
	9. Cavitation shock loading.	9. See Cavitation, Fluid Knock or Hammer problem.
Stud Failures.	1. Catastrophic failures.	1. See Catastrophic Failures problem.
	2. Improper nut torquing.	2. Check torque specifications and torque to correct values.
	3. Stud bending due to uneven nut seating.	3. Check nut seat surface for flatness. Rework or replace as required.
	4. Corrosive attack by pumped fluid.	4. Treat fluid or use corrosion resistant studs.
	5. Studs damaged before installation.	5. Check condition before installation, and replace if necessary.
	6. Low strength studs.	6. Use Gardner Denver studs.

SECTION 5
REBUILDING DATA AND TORQUES

PUMP DATA SHEET
MODEL: TQB (GD25T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 27 HP (19 kW)
MAXIMUM CRANKSHAFT RPM: 600 RPM
MINIMUM CRANKSHAFT RPM: 225 RPM
STROKE: 2.00 IN. (51 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 2.5 GAL. (9.5 LITERS)

MAXIMUM PLUNGER LOAD: 2670 LB (1210 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 2.00 IN. (50.8 mm)
LENGTH: 3.25 IN. (82 mm)
KEYWAY (L x W x H): 2–3/4 x 1/2 x 1/2
PUMP WEIGHT: 570 LB (258 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size In. (mm)	Pressure PSI (Kg/Cm2)	Size In. (mm)	Pressure PSI (Kg/Cm2)	Standard Connections	
Description					Suction	Discharge
TQBA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	2–1/4 (57)	670 (47)	1 (25)	2250 (158)	2.5” NPT (63.5 mm)	2” NPT (50.8 mm)
TQBB – LP NODULAR IRON (TAPERED SEAT VALVES)	2–1/4 (57)	670 (47)	1 (25)	2250 (158)	2.5” NPT (63.5 mm)	2” NPT (50.8 mm)
TQBC – LP STAINLESS STEEL (TAPERED SEAT VALVES)	2–1/4 (57)	670 (47)	1 (25)	2250 (158)	3”–3000# SAE 4 BOLT FLANGE	2”–3000# SAE 4 BOLT FLANGE
TQBD – LP BLOCK STEEL (TAPERED SEAT VALVES)	2–1/4 (57)	670 (47)	1 (25)	2250 (158)	3”–900# ANSI RTJ FLANGE	2”–1500# ANSI RTJ FLANGE

REBUILDING DATA FOR TQB (GD25T) PUMPS

PUMP MODEL	TQB (GD25T)	TQB (GD25T)
PUMP STROKE	2 IN.	50.8 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	2.623/2.624	66.624/66.650
Crankpin Width	1.504/1.515	38.202/38.481
Crankshaft Diameter at Main Bearing	2.126/2.127	54.000/54.026
Distance Between Main Bearings	13.750/13.760	349.250/349.504
Bore in Housing for Main Bearing	4.248/4.250	107.899/107.950
Connecting Rod Centers	5.5	139.7
Bore in Connecting Rod for Crosshead Pin	1.0065/1.0075	25.5651/25.5905
Bore in Connecting Rod for Insert	2.775/2.776	70.485/70.510
Crosshead Pin Diameter	1.0080/1.0082	25.6032/25.6083
Crosshead Pin Bushing Bore (Honed)	1.0095/1.0100	25.6413/25.6540
Bore in Crosshead for Bushing	1.249/1.250	31.725/31.750
RUNNING CLEARANCES – ACTUAL*:		
Crankpin Bearing	.0006/.0036	.0152/.0914
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0013/.0020	.0330/.0508
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TQB (GD25T)

MODEL DESCRIPTION	TQBA LP ALUMINUM BRONZE		TQBB LP NODULAR IRON		TQBC LP STAINLESS STEEL		TQBD LP BLOCK STEEL	
DISCHARGE VALVE SEAT								
GAGE DIAMETER – IN (mm)	3.125	(79.375)	3.125	(79.375)	3.125	(79.375)	3.125	(79.375)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT								
GAGE DIAMETER – IN (mm)	2.625	(66.675)	2.625	(66.675)	2.625	(66.675)	2.625	(66.675)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS								
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	180	(245)	180	(245)	180	(245)	180	(245)
STUFFING BOX TO FLUID NUTS								
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	75	(100)	75	(100)	75	(100)	75	(100)
DISCHARGE VALVE COVER NUTS								
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	260	(352)	260	(352)	260	(352)	260	(352)
DISCHARGE MANIFOLD TO CYLINDER NUTS								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)								
DISCHARGE FLANGE FASTENERS								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)							430	(583)
SUCTION VALVE COVER NUTS								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)							260	(352)
SUCTION MANIFOLD TO CYLINDER NUTS								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)								
SUCTION FLANGE FASTENERS								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)							430	(583)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS								
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	15	(20)	15	(20)	15	(20)	15	(20)
WING–GUIDED VALVES–CAGE TO SEAT								
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT								
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER								
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS								
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)								
EXTENSION ROD TO CROSSHEAD								
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)								

PUMP DATA SHEET
MODEL: TQW (GD45T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 45 HP (34 kW)
MAXIMUM CRANKSHAFT RPM: 575 RPM
MINIMUM CRANKSHAFT RPM: 225 RPM
STROKE: 2.50 IN. (63 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 4 GAL. (15 LITERS)

MAXIMUM PLUNGER LOAD: 3770 LB (1710 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 2.5 IN. (63.5 mm)
LENGTH: 4.12 IN. (105 mm)
KEYWAY (L x W x H): 2–3/4 x 5/8 x 5/8
PUMP WEIGHT: 775 LB (352 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size	Pressure	Size	Pressure		
	In.	PSI	In.	PSI	Standard Connections	
Description	(mm)	(Kg/Cm2)	(mm)	(Kg/Cm2)	Suction	Discharge
TQWA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	2–3/4 (70)	635 (44)	1–3/4 (44)	1380 (97)	2.5” NPT (63.5 mm)	2” NPT (50.8 mm)
TQWB – HP ALUMINUM BRONZE (TAPERED SEAT VALVES)	1–1/2 (38)	1900 (135)	7/8 (22)	5000 (352)	3” NPT (63.5 mm)	2” NPT (50.8 mm)
TQWC – LP NODULAR IRON (TAPERED SEAT VALVES)	2–3/4 (70)	635 (44)	1–3/4 (44)	1380 (97)	2.5” NPT (63.5 mm)	2” NPT (50.8 mm)
TQWD – LP BLOCK STEEL (TAPERED SEAT VALVES)	2–3/4 (70)	635 (44)	1–3/4 (44)	2250 (158)	3”–900# ANSI RTJ FLANGE	2”–1500# ANSI RTJ FLANGE
TQWE – LP STAINLESS STEEL (TAPERED SEAT VALVES)	2–3/4 (70)	635 (44)	1–3/4 (44)	2250 (158)	2.5”–3000# SAE 4 BOLT FLANGE	2”–3000# SAE 4 BOLT FLANGE

REBUILDING DATA FOR TQW (GD45T) PUMPS

PUMP MODEL	TQW (GD45T)	TQW (GD45T)
PUMP STROKE	2–1/2 IN.	63.5 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	2.999/3.000	76.175/76.200
Crankpin Width	1.879/1.890	47.727/48.006
Crankshaft Diameter at Main Bearing	2.626/2.627	66.700/66.726
Distance Between Main Bearings	15.000/15.010	381.000/381.254
Bore in Housing for Main Bearing	4.8105/4.8125	122.1867/122.2375
Connecting Rod Centers	6.875	174.625
Bore in Connecting Rod for Crosshead Pin	1.2565/1.2575	31.9151/31.9405
Bore in Connecting Rod for Insert	3.194/3.195	81.128/81.153
Crosshead Pin Diameter	1.2580/1.2582	31.9532/31.9583
Crosshead Pin Bushing Bore (Honed)	1.2595/1.2600	31.9913/32.0040
Bore in Crosshead for Bushing	1.499/1.500	38.075/38.100
RUNNING CLEARANCES – ACTUAL*:		
Crankpin Bearing	.0008/.0038	.0203/.0965
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0013/.0020	.0330/.0508
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TQW (GD45T)

MODEL DESCRIPTION	TQWA LP ALUMINUM BRONZE		TQWB HP ALUMINUM BRONZE		TQWC LP NODULAR IRON		TQWD LP BLOCK STEEL		TQWE LP STAINLESS STEEL	
DISCHARGE VALVE SEAT										
GAGE DIAMETER – IN (mm)	3.125	(79.375)	2.250	(57.150)	3.125	(79.375)	3.125	(79.375)	3.125	(79.375)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	2.00	(50.8)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT										
GAGE DIAMETER – IN (mm)	2.625	(66.675)	1.500	(38.100)	2.625	(66.675)	2.625	(66.675)	2.625	(66.675)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	2.00	(50.8)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS										
THREAD SIZE – IN (mm)	5/8–11	(15.8)	3/4–10	(19.0)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	180	(245)	300	(407)	180	(245)	180	(245)	180	(245)
STUFFING BOX TO FLUID NUTS										
THREAD SIZE – IN (mm)	5/8–11	(15.8)	3/4–10	(19.0)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	100	(135)	150	(205)	100	(135)	100	(135)	100	(135)
DISCHARGE VALVE COVER NUTS										
THREAD SIZE – IN (mm)	3/4–10	(19.0)	5/8–11	(15.8)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	260	(352)	150	(203)	260	(352)	260	(352)	260	(352)
DISCHARGE MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
DISCHARGE FLANGE FASTENERS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		7/8–9	(22.2)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)							430	(583)	110	(14.9)
SUCTION VALVE COVER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
SUCTION MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		1/2–13	(12.7)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)			75	(102)						
SUCTION FLANGE FASTENERS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		7/8–9	(22.2)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)							430	(583)	110	(149)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS										
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	15	(20)	15	(20)	15	(20)	15	(20)	15	(20)
WING–GUIDED VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER										
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	20	(27)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)	75	(102)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
EXTENSION ROD TO CROSSHEAD										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										

PUMP DATA SHEET
MODEL: TQC (GD50T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 50 HP (37 kW)
MAXIMUM CRANKSHAFT RPM: 400 RPM
MINIMUM CRANKSHAFT RPM: 200 RPM
STROKE: 3.00 IN. (76 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 6.5 GAL. (25 LITERS)

MAXIMUM PLUNGER LOAD: 4948 LB (2249 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 2.625 IN. (66.7 mm)
LENGTH: 4.12 IN. (105 mm)
KEYWAY (L x W x H): 3–1/2 x 5/8 x 5/8
PUMP WEIGHT: 970 LB (440 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size In. (mm)	Pressure PSI (Kg/Cm2)	Size In. (mm)	Pressure PSI (Kg/Cm2)	Standard Connections Suction	Discharge
TQCB – LP BLOCK STEEL (TAPERED SEAT VALVES)	3 (76)	700 (48)	1–3/4 (44)	2058 (142)	3”–900# ANSI RTJ FLANGE	2”–1500# ANSI RTJ FLANGE
TQCC – LP STAINLESS STEEL (TAPERED SEAT VALVES)	3 (76)	700 (48)	1–3/4 (44)	2058 (142)	3”–3000# SAE 4 BOLT FLANGE	2”–3000# SAE 4 BOLT FLANGE
TQCD – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	700 (48)	1–3/4 (44)	2058 (142)	3” NPT (76.2 mm)	2” NPT (50.8 mm)

REBUILDING DATA FOR TQC (GD50T) PUMPS

PUMP MODEL	TQC (GD50T)	TQC (GD50T)
PUMP STROKE	3 IN.	76.2 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	3.249/3.250	82.525/82.550
Crankpin Width	2.504/2.515	63.602/63.881
Crankshaft Diameter at Main Bearing	2.814/2.815	71.476/71.501
Distance Between Main Bearings	17.750/17.760	450.850/451.104
Bore in Housing for Main Bearing	5.373/5.375	136.474/136.525
Connecting Rod Centers	8.250	209.550
Bore in Connecting Rod for Crosshead Pin	1.5065/1.5075	38.2651/38.2905
Bore in Connecting Rod for Insert	3.444/3.445	87.478/87.503
Crosshead Pin Diameter	1.5080/1.5082	38.3032/38.3083
Crosshead Pin Bushing Bore (Honed)	1.5090/1.5095	38.3286/38.3413
Bore in Crosshead for Bushing	1.749/1.750	44.425/44.450

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0008/.0048	.0203/.1219
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0008/.0015	.0203/.0381
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TQC (GD50T)

MODEL DESCRIPTION	TQCB LP BLOCK STEEL		TQCC LP STAINLESS STEEL		TQCD LP ALUMINUM BRONZE	
DISCHARGE VALVE SEAT						
GAGE DIAMETER – IN (mm)	3.125	(79.375)	3.125	(79.375)	2.625	(66.675)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT						
GAGE DIAMETER – IN (mm)	2.625	(66.675)	2.625	(66.675)	2.625	(66.675)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS						
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	180	(245)	180	(245)	180	(245)
STUFFING BOX TO FLUID NUTS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	90	(122)	90	(122)	90	(122)
DISCHARGE VALVE COVER NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	260	(352)	260	(352)	175	(237)
DISCHARGE MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
DISCHARGE FLANGE FASTENERS						
THREAD SIZE – IN (mm)	7/8–9	(22.2)	1/2–13	(12.7)	N/A	
TORQUE–DRY FT–LB (Nm)	430	(583)	110	(149)		
SUCTION VALVE COVER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)					175	(237)
SUCTION MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
SUCTION FLANGE FASTENERS						
THREAD SIZE – IN (mm)	7/8–9	(22.2)	5/8–11	(15.8)	N/A	
TORQUE–DRY FT–LB (Nm)	430	(583)	220	(298)		
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS						
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	15	(20)	15	(20)	15	(20)
WING–GUIDED VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER						
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
EXTENSION ROD TO CROSSHEAD						
THREAD SIZE – IN (mm)	7/8–9	(22.2)	7/8–9	(22.2)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	75–100	(102–136)	75–100	(102–136)	75–100	(102–136)

PUMP DATA SHEET
MODEL: TAC (GD60T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 60 HP (45 kW)
MAXIMUM CRANKSHAFT RPM: 500 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 3.00 IN. (76 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 6 GAL. (23 LITERS)

MAXIMUM PLUNGER LOAD: 4752 LB (2160 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 2.625 IN. (66.7 mm)
LENGTH: 5.00 IN. (127 mm)
KEYWAY (L x W x H): 4–3/8 x 5/8 x 5/8
PUMP WEIGHT: 1790 LB (812 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size In. (mm)	Pressure PSI (Kg/Cm2)	Size In. (mm)	Pressure PSI (Kg/Cm2)	Standard Connections Suction	Discharge
Description						
TACA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	675 (47)	1–3/4 (44)	2000 (137)	3”–150# ANSI FLANGE	2”–1500# ANSI FLANGE
TACB – HP ALUMINUM BRONZE (TAPERED SEAT VALVES)	1–1/2 (38)	2680 (185)	1 (25)	5000 (345)	3”–150# ANSI FLANGE	1.5”–2500# ANSI FLANGE
TACC – MP BLOCK STEEL (TAPERED SEAT VALVES)	2–1/4 (57)	1190 (82)	1–3/4 (44)	2000 (137)	3”–900# ANSI FLANGE	2”–1500# ANSI FLANGE
TACD – MP STAINLESS STEEL (TAPERED SEAT VALVES)	2–1/4 (57)	1190 (82)	1–3/4 (44)	2000 (137)	3”–3000# SAE 4 BOLT FLANGE	2”–3000# SAE 4 BOLT FLANGE
TACE – LP BLOCK STEEL (TAPERED SEAT VALVES)	3 (76)	675 (47)	1–1/2 (38)	2220 (153)	3”–900# ANSI FLANGE	2”–1500# ANSI RTJ FLANGE
TACF – LP STAINLESS STEEL (TAPERED SEAT VALVES)	3 (76)	675 (47)	1–1/2 (38)	2220 (153)	3”–3000# SAE 4 BOLT FLANGE	2”–3000# SAE 4 BOLT FLANGE

REBUILDING DATA FOR TAC (GD60T) PUMPS

PUMP MODEL	TAC (GD60T)	TAC (GD60T)
PUMP STROKE	3 IN.	76.2 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	3.248/3.249	82.499/82.525
Crankpin Width	2.504/2.515	63.601/63.881
Crankshaft Diameter at Main Bearing	2.8765/2.8775	73.0631/73.0885
Distance Between Main Bearings	17.750/17.760	450.850/451.104
Bore in Housing for Main Bearing	5.873/5.875	149.174/149.225
Connecting Rod Centers	8.250	209.550
Bore in Connecting Rod for Crosshead Pin	1.5065/1.5075	38.2651/38.2905
Bore in Connecting Rod for Insert	3.444/3.445	87.478/87.503
Crosshead Pin Diameter	1.5080/1.5082	38.3032/38.3083
Crosshead Pin Bushing Bore (Honed)	1.5090/1.5095	38.3286/38.3413
Bore in Crosshead for Bushing	1.749/1.750	44.425/44.450

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0008/.0048	.0203/.1219
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0008/.0015	.0203/.0381
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TAC (GD60T)

MODEL DESCRIPTION	TACA LP ALUMINUM BRONZE		TACB LP ALUMINUM BRONZE		TACC MP BLOCK STEEL	
DISCHARGE VALVE SEAT						
GAGE DIAMETER – IN (mm)	4.125	(104.775)	2.375	(60.325)	3.125	(79.375)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT						
GAGE DIAMETER – IN (mm)	3.125	(79.375)	1.625	(41.275)	2.625	(66.675)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)	300	(407)
STUFFING BOX TO FLUID NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)	300	(407)
DISCHARGE VALVE COVER NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	7/8–9	(22.2)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	430	(583)	300	(407)
DISCHARGE MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
DISCHARGE FLANGE FASTENERS						
THREAD SIZE – IN (mm)	7/8–9	(22.2)	1–1/8–7	(28.6)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	430	(583)	800	(1084)	430	(583)
SUCTION VALVE COVER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)					300	(406)
SUCTION MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		1/2–13	(12.7)	N/A	
TORQUE–DRY FT–LB (Nm)			75	(102)		
SUCTION FLANGE FASTENERS						
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	150	(203)	150	(203)	430	(583)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	15	(20)	15	(20)
WING–GUIDED VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER						
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
EXTENSION ROD TO CROSSHEAD						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						

TAC (GD60T) (Continued)

MODEL DESCRIPTION	TACD MP STAINLESS STEEL		TACE LP BLOCK STEEL		TACF LP STAINLESS STEEL	
DISCHARGE VALVE SEAT						
GAGE DIAMETER – IN (mm)	3.125	(79.375)	4.125	(104.775)	4.125	(104.775)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT						
GAGE DIAMETER – IN (mm)	2.625	(66.675)	3.125	(79.375)	3.125	(79.375)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)	300	(407)
STUFFING BOX TO FLUID NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)	300	(407)
DISCHARGE VALVE COVER NUTS						
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)	300	(407)
DISCHARGE MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
DISCHARGE FLANGE FASTENERS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	7/8–9	(22.2)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	110	(149)	430	(583)	110	(149)
SUCTION VALVE COVER NUTS						
THREAD SIZE – IN (mm)	N/A		3/4–10	(19.0)	N/A	
TORQUE–DRY FT–LB (Nm)			300	(406)		
SUCTION MANIFOLD TO CYLINDER NUTS						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
SUCTION FLANGE FASTENERS						
THREAD SIZE – IN (mm)	5/8–11	(15.8)	7/8–9	(22.2)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	220	(298)	430	(583)	220	(298)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS						
THREAD SIZE – IN (mm)	3/8–16	(9.5)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	15	(20)	20	(27)	20	(27)
WING–GUIDED VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT						
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER						
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS						
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						
EXTENSION ROD TO CROSSHEAD						
THREAD SIZE – IN (mm)	N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)						

PUMP DATA SHEET
MODEL: TDD (GD100T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 103 HP (77 kW)
MAXIMUM CRANKSHAFT RPM: 425 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 4.00 IN. (102 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 10.5 GAL. (40 LITERS)

MAXIMUM PLUNGER LOAD: 7175 LB (3255 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 2.875 IN. (73.0 mm)
LENGTH: 6.00 IN. (152 mm)
KEYWAY (L x W x H): 5 x 3/4 x 3/4
PUMP WEIGHT: 2900 LB (1315 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size In. (mm)	Pressure PSI (Kg/Cm2)	Size In. (mm)	Pressure PSI (Kg/Cm2)	Standard Connections	
Description					**Suction**	**Discharge**
TDDA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3–1/2 (89)	745 (52)	2–1/2 (64)	1460 (103)	4”–150# ANSI FLANGE	3”–600# ANSI FLANGE
TDDB – MP ALUMINUM BRONZE (TAPERED SEAT VALVES)	2–1/2 (64)	1460 (103)	1–3/4 (44)	2980 (209)	3”–150# ANSI FLANGE	2”–1500# ANSI FLANGE

REBUILDING DATA FOR TDD (GD100T) PUMPS

PUMP MODEL	TDD (GD100T)	TDD (GD100T)
PUMP STROKE	4 IN.	101.6 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	3.999/4.000	101.575/101.600
Crankpin Width	3.004/3.015	76.302/76.581
Crankshaft Diameter at Main Bearing	3.0015/3.0025	76.2381/76.2635
Distance Between Main Bearings	19.500/19.510	495.300/495.554
Bore in Housing for Main Bearing	7.498/7.500	190.449/190.500
Connecting Rod Centers	10.500	266.700
Bore in Connecting Rod for Crosshead Pin	2.0065/2.0075	50.9651/50.9905
Bore in Connecting Rod for Insert	4.193/4.194	106.502/106.528
Crosshead Pin Diameter	2.0080/2.0085	51.0032/51.0159
Crosshead Pin Bushing Bore (Honed)	2.0090/2.0095	51.0286/51.0413
Bore in Crosshead for Bushing	2.249/2.250	57.125/57.150

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0010/.0040	.0254/.1016
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0005/.0015	.0127/.0381
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TDD (GD100T)

MODEL DESCRIPTION	TDDA LP ALUMINUM BRONZE		TDDB MP ALUMINUM BRONZE	
DISCHARGE VALVE SEAT				
GAGE DIAMETER – IN (mm)	4.256	(108.1)	3.172	(80.6)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)
SUCTION VALVE SEAT				
GAGE DIAMETER – IN (mm)	3.298	(83.8)	2.859	(72.6)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)
FLUID CYLINDER TO FRAME NUTS				
THREAD SIZE – IN (mm)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	700	(950)	700	(950)
STUFFING BOX TO FLUID NUTS				
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	180	(245)	180	(245)
DISCHARGE VALVE COVER NUTS				
THREAD SIZE – IN (mm)	1–1/8–7	(28.6)	1–1/8–7	(28.6)
TORQUE–DRY FT–LB (Nm)	1000	(1355)	1000	(1355)
DISCHARGE MANIFOLD TO CYLINDER NUTS				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
DISCHARGE FLANGE FASTENERS				
THREAD SIZE – IN (mm)	3/4–10	(19.0)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	260	(352)	430	(583)
SUCTION VALVE COVER NUTS				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
SUCTION MANIFOLD TO CYLINDER NUTS				
THREAD SIZE – IN (mm)	N/A		1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)			75	(102)
SUCTION FLANGE FASTENERS				
THREAD SIZE – IN (mm)	5/8–11	(15.8)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	150	(203)	150	(203)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS				
THREAD SIZE – IN (mm)	1/2–13	(12.7)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	15	(20)
WING–GUIDED VALVES–CAGE TO SEAT				
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT				
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER				
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS				
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
EXTENSION ROD TO CROSSHEAD				
THREAD SIZE – IN (mm)	1–3/8–6	(34.9)	1–3/8–6	(34.9)
TORQUE–DRY FT–LB (Nm)	100–150	(136–204)	100–150	(136–204)

PUMP DATA SHEET
MODEL: QBX (GD135Q)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 135 HP (101 kW)
MAXIMUM CRANKSHAFT RPM: 500 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 3.50 IN. (88.9 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 10.0 GAL. (38 LITERS)

MAXIMUM PLUNGER LOAD: 5500 LB (2495 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 3.00 IN. (76.2 mm)
LENGTH: 5.50 IN. (139.7 mm)
KEYWAY (L x W x H): 5 x .75 x .75
PUMP WEIGHT: 1875 LB (851 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size	Pressure	Size	Pressure		
	In.	PSI	In.	PSI	Standard Connections	
Description	(mm)	(Kg/Cm2)	(mm)	(Kg/Cm2)	Suction	Discharge
QBXA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	778 (55)	2 (51)	1480 (104)	6”–150# ANSI FLANGE	3”–600# ANSI FLANGE
QBXB – MP ALUMINUM BRONZE (TAPERED SEAT VALVES)	2–1/4 (57)	1383 (97)	1–1/2 (38)	3111 (218)	4”–150# ANSI FLANGE	3”–1500# ANSI FLANGE

REBUILDING DATA FOR QBX (GD135Q) PUMPS

PUMP MODEL	QBX (GD135Q)	QBX (GD135Q)
PUMP STROKE	3.5 IN.	88.9 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	3.498/3.499	88.849/88.875
Crankpin Width	2.504/2.515	63.602/63.881
Crankshaft Diameter at Main Bearing	3.5015/3.5025	88.9381/88.9635
Distance Between Main Bearings	7.4810/7.4815	190.0174/190.0301
Bore in Housing for Main Bearing	5.873/5.875	149.174/149.225
Connecting Rod Centers	9.30	236.22
Bore in Connecting Rod for Crosshead Pin	1.5065/1.5075	38.2651/38.2905
Bore in Connecting Rod for Insert	3.694/3.695	93.828/93.853
Crosshead Pin Diameter	1.5080/1.5085	38.3032/38.3159
Crosshead Pin Bushing Bore (Honed)	1.5090/1.5095	38.3286/38.3413
Bore in Crosshead for Bushing	1.749/1.750	44.425/44.450

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0008/.0048	.0203/.1219
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0008/.0015	.0203/.0381
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.010	.152/.254

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

QBX (GD135Q)

MODEL DESCRIPTION	QBXA LP ALUMINUM BRONZE		QBXB MP ALUMINUM BRONZE	
DISCHARGE VALVE SEAT				
GAGE DIAMETER – IN (mm)	3.172	(80.569)	2.859	(72.618)
GAGE DIAMETER – IN/FT (mm/M)	1.500	(38.10)	1.500	(38.10)
SUCTION VALVE SEAT				
GAGE DIAMETER – IN (mm)	2.859	(72.618)	2.375	(60.325)
GAGE DIAMETER – IN/FT (mm/M)	1.500	(38.10)	1.500	(38.10)
FLUID CYLINDER TO FRAME NUTS				
THREAD SIZE – IN (mm)	3/4–10	(19.0)	3/4–10	(19.0)
TORQUE–DRY FT–LB (Nm)	300	(407)	300	(407)
STUFFING BOX TO FLUID NUTS				
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	90	(122)	90	(122)
DISCHARGE VALVE COVER NUTS				
THREAD SIZE – IN (mm)	1–1/8–7	(28.6)	1–1/8–7	(28.6)
TORQUE–DRY FT–LB (Nm)	1000	(1355)	1000	(1355)
DISCHARGE MANIFOLD TO CYLINDER NUTS				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
DISCHARGE FLANGE FASTENERS				
THREAD SIZE – IN (mm)	3/4–10	(19.0)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	260	(352)	430	(583)
SUCTION VALVE COVER NUTS				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
SUCTION MANIFOLD TO CYLINDER NUTS				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
SUCTION FLANGE FASTENERS				
THREAD SIZE – IN (mm)	3/4–10	(19.0)	5/8–11	(15.8)
TORQUE–DRY FT–LB (Nm)	260	(352)	150	(203)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS				
THREAD SIZE – IN (mm)	1/2–13	(15.8)	1/2–13	(15.8)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)
WING–GUIDED VALVES–CAGE TO SEAT				
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)
SEVERE DUTY VALVES–CAGE TO SEAT				
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)
PLUNGER COUPLING FASTENER				
THREAD SIZE – IN (mm)	3/8–16	(9.5)	3/8–16	(9.5)
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)
CONNECTING ROD CAP FASTENERS				
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(102)	75	(102)
CONNECTING ROD PINCH BOLT				
THREAD SIZE – IN (mm)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)				
EXTENSION ROD TO CROSSHEAD				
THREAD SIZE – IN (mm)	7/8–9	(22.2)	7/8–9	(22.2)
TORQUE–DRY FT–LB (Nm)	75–100	(102–136)	75–100	(102–136)

PUMP DATA SHEET
MODEL: TAE (GD150T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 150 HP (112 kW)
MAXIMUM CRANKSHAFT RPM: 370 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 5.00 IN. (127 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 14.5 GAL. (55 LITERS)

MAXIMUM PLUNGER LOAD: 9633 LB (4378 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 4.00 IN. (101.6 mm)
LENGTH: 8.00 IN. (202 mm)
KEYWAY (L x W x H): 7–1/8 x 1 x 1
PUMP WEIGHT: 3032 LB (1375 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size	Pressure	Size	Pressure		
	In.	PSI	In.	PSI	Standard Connections	
Description	(mm)	(Kg/Cm2)	(mm)	(Kg/Cm2)	Suction	Discharge
TAEF – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	4–1/4 (108)	680 (48)	3 (76)	1365 (96)	6”–150# ANSI FLANGE	3”–2000# API RJ FLANGE
TAEG – MP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	1365 (96)	2 (51)	3065 (216)	4”–150# ANSI FLANGE	2”–1500# ANSI FLANGE
TAEH – HP BLOCK STEEL (TAPERED SEAT VALVES)	2 (54)	3065 (216)	1–1/4 (32)	7845 (552)	3”–300# ANSI FLANGE	1–13/16” API 10000# RJ FLANGE
TAEL – HP BLOCK STEEL (CLAMPED IN VALVES)	2 (54)	3065 (216)	1–1/4 (32)	7500 (528)	3”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL
TAEM – STEEL–EXTRA HIGH PRESSURE BLOCK (CLAMPED IN VALVES)	1–1/2 (38)	5445 (383)	1 (25)	12000 (842)	2”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL

REBUILDING DATA FOR TAE (GD150T) PUMPS

PUMP MODEL	TAE (GD150T)	TAE (GD150T)
PUMP STROKE	5 IN.	127 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	4.998/4.999	126.949/126.975
Crankpin Width	3.504/3.515	89.002/89.281
Crankshaft Diameter at Main Bearing	4.2515/4.2525	107.9881/108.0135
Distance Between Main Bearings	21.875/21.885	555.625/555.879
Bore in Housing for Main Bearing	8.373/8.375	212.674/212.725
Connecting Rod Centers	13.0625	331.7875
Bore in Connecting Rod for Crosshead Pin	3.000/3.002	76.200/76.251
Bore in Connecting Rod for Insert	5.224/5.225	132.690/132.715
Crosshead Pin Diameter	3.0000/3.0005	76.2000/76.2127
Crosshead Pin Bushing Bore (Honed)	3.0015/3.0020	76.2381/76.2508
Bore in Crosshead for Bushing	3.374/3.375	85.699/85.725

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0022/.0056	.0559/.1422
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0010/.0020	.0254/.0508
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.011	.152/.279

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TAE (GD150T)

MODEL DESCRIPTION	TAEF LP ALUM BRONZE		TAEG MP ALUM BRONZE		TAEH LP BLOCK STEEL		TAEL HP BLOCK STEEL		TAEM XHP BLOCK STEEL	
DISCHARGE VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.750	(120.650)	4.125	(104.775)	3.125	(79.375)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
SUCTION VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.125	(104.775)	3.125	(79.375)	2.625	(66.675)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
FLUID CYLINDER TO FRAME NUTS										
THREAD SIZE – IN (mm)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	700	(950)	700	(950)	700	(950)	700	(950)	700	(950)
STUFFING BOX TO FLUID NUTS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	3/4–10	(19.05)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	90	(122)	300	(407)	700	(950)	700	(950)	700	(950)
DISCHARGE VALVE COVER NUTS										
THREAD SIZE – IN (mm)	1–1/8–7	(28.5)	1–1/8–7	(28.5)	1–8	(25.4)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	1000	(1355)	1000	(1355)	700	(950)				
DISCHARGE MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)							1360	(1845)	1360	(1845)
DISCHARGE FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.0)	7/8–9	(22.2)	3/4–10	(19.05)	3/4–10	(19.05)	3/4–10	(19.05)
TORQUE–DRY FT–LB (Nm)	260	(352)	430	(583)	260	(352)	380	(515)	380	(515)
SUCTION VALVE COVER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
SUCTION MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		1/2–13	(12.7)	1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)					75	(101)	1360	(1845)	1360	(1845)
SUCTION FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.05)	5/8–11	(15.88)	3/4–10	(19.05)	5/8–11	(15.88)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	260	(352)	150	(203)	260	(352)	220	(298)	110	(149)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	3/8–16	(9.5)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	15	(20)				
WING–GUIDED VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
SEVERE DUTY VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
PLUNGER COUPLING FASTENER										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.5)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	50	(67)	50	(67)	50	(67)	50	(67)	50	(67)
CONNECTING ROD CAP FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
CONNECTING ROD PINCH BOLT										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
EXTENSION ROD TO CROSSHEAD										
THREAD SIZE – IN (mm)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)
TORQUE–DRY FT–LB (Nm)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)

PUMP DATA SHEET
MODEL: TDE (GD180T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 180 HP (134 kW)
MAXIMUM CRANKSHAFT RPM: 370 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 5.00 IN. (127 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 14.5 GAL. (55 LITERS)

MAXIMUM PLUNGER LOAD: 11560 LB (5242 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 4.00 IN. (101.6 mm)
LENGTH: 8.00 IN. (202 mm)
KEYWAY (L x W x H): 7–1/8 x 1 x 1
PUMP WEIGHT: 3032 LB (1375 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size	Pressure	Size	Pressure		
	In.	PSI	In.	PSI	Standard Connections	
Description	(mm)	(Kg/Cm2)	(mm)	(Kg/Cm2)	Suction	Discharge
TDEA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	4–1/4 (108)	815 (57)	3 (76)	1635 (115)	6”–150# ANSI FLANGE	3”–2000# API RJ FLANGE
TDEB – MP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	1635 (115)	2 (51)	3680 (259)	4”–150# ANSI FLANGE	2”–1500# ANSI FLANGE
TDEC – HP BLOCK STEEL (TAPERED SEAT VALVES)	2 (54)	3680 (259)	1–1/4 (32)	9415 (662)	3”–300# ANSI FLANGE	1–13/16” API 10000# RJ FLANGE
TDEF – HP BLOCK STEEL (CLAMPED IN VALVES)	2 (54)	3680 (259)	1–1/4 (32)	7500 (528)	3”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL
TDEG – STEEL–EXTRA HIGH PRESSURE BLOCK (CLAMPED IN VALVES)	1–1/2 (38)	6535 (459)	1 (25)	12000 (842)	2”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL

REBUILDING DATA FOR TDE (GD180T) PUMPS

PUMP MODEL	TDE (GD180T)	TDE (GD180T)
PUMP STROKE	5 IN.	127 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	4.998/4.999	126.949/126.975
Crankpin Width	3.504/3.515	89.002/89.281
Crankshaft Diameter at Main Bearing	4.2515/4.2525	107.9881/108.0135
Distance Between Main Bearings	21.875/21.885	555.625/555.879
Bore in Housing for Main Bearing	8.373/8.375	212.674/212.725
Connecting Rod Centers	13.0625	331.7875
Bore in Connecting Rod for Crosshead Pin	3.000/3.002	76.200/76.251
Bore in Connecting Rod for Insert	5.224/5.225	132.690/132.715
Crosshead Pin Diameter	3.0000/3.0005	76.2000/76.2127
Crosshead Pin Bushing Bore (Honed)	3.0015/3.0020	76.2381/76.2508
Bore in Crosshead for Bushing	3.374/3.375	85.699/85.725

RUNNING CLEARANCES – ACTUAL*:

Crankpin Bearing	.0022/.0056	.0559/.1422
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0010/.0020	.0254/.0508
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.011	.152/.279

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TDE (GD180T)

MODEL DESCRIPTION	TDEA LP ALUMINUM BRONZE		TDEB MP ALUMINUM BRONZE		TDEC HP BLOCK STEEL		TDEF HP BLOCK STEEL		TDEG XHP BLOCK STEEL	
DISCHARGE VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.750	(120.650)	4.125	(104.775)	3.125	(79.375)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
SUCTION VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.125	(104.775)	3.125	(79.375)	2.625	(66.675)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
FLUID CYLINDER TO FRAME NUTS										
THREAD SIZE – IN (mm)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	700	(950)	700	(950)	700	(950)	700	(950)	700	(950)
STUFFING BOX TO FLUID NUTS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	3/4–10	(19.05)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	90	(122)	300	(407)	700	(950)	700	(950)	700	(950)
DISCHARGE VALVE COVER NUTS										
THREAD SIZE – IN (mm)	1–1/8–7	(28.5)	1–1/8–7	(28.5)	1–8	(25.4)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	1000	(1355)	1000	(1355)	700	(950)				
DISCHARGE MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)							1360	(1845)	1360	(1845)
DISCHARGE FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.05)	7/8–9	(22.2)	3/4–10	(19.05)	3/4–10	(19.05)	3/4–10	(19.05)
TORQUE–DRY FT–LB (Nm)	260	(352)	430	(583)	260	(352)	380	(515)	380	(515)
SUCTION VALVE COVER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
SUCTION MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		1/2–13	(12.7)	1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)					75	(101)	1360	(1845)	1360	(1845)
SUCTION FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.05)	5/8–11	(15.88)	3/4–10	(19.05)	5/8–11	(15.88)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	260	(352)	150	(203)	260	(352)	220	(298)	110	(149)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	3/8–16	(9.5)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	15	(20)				
WING–GUIDED VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
SEVERE DUTY VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
PLUNGER COUPLING FASTENER										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	50	(67)	50	(67)	50	(67)	50	(67)	50	(67)
CONNECTING ROD CAP FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
CONNECTING ROD PINCH BOLT										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
EXTENSION ROD TO CROSSHEAD										
THREAD SIZE – IN (mm)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9
TORQUE–DRY FT–LB (Nm)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)

PUMP DATA SHEET
MODEL: TFE (GD200T)

SPECIFICATIONS:

MAXIMUM HORSEPOWER: 205 HP (153 kW)
MAXIMUM CRANKSHAFT RPM: 370 RPM
MINIMUM CRANKSHAFT RPM: 175 RPM
STROKE: 5.00 IN. (127 mm)
NUMBER OF PLUNGERS: 3
TYPE OF LUBRICATION: SPLASH
OIL CAPACITY: 14.5 GAL. (55 LITERS)

MAXIMUM PLUNGER LOAD: 13182 LB (5979 Kg)
CRANKSHAFT EXTENSION:
DIAMETER: 4.00 IN. (101.6 mm)
LENGTH: 8.00 IN. (202 mm)
KEYWAY (L x W x H): 7–1/8 x 1 x 1
PUMP WEIGHT: 3032 LB (1375 Kg) APPROXIMATE

STANDARD FLUID CYLINDERS:

	Max Plunger		Min Plunger			
	Size In. (mm)	Pressure PSI (Kg/Cm2)	Size In. (mm)	Pressure PSI (Kg/Cm2)	Standard Connections Suction	Discharge
Description						
TFEA – LP ALUMINUM BRONZE (TAPERED SEAT VALVES)	4–1/4 (108)	930 (65)	3 (76)	1865 (131)	6”–150# ANSI FLANGE	3”–2000# API RJ FLANGE
TFEB – MP ALUMINUM BRONZE (TAPERED SEAT VALVES)	3 (76)	1865 (131)	2 (51)	3705 (260)	4”–150# ANSI FLANGE	2”–1500# ANSI FLANGE
TFEC – HP BLOCK STEEL (TAPERED SEAT VALVES)	2 (54)	4190 (295)	1–1/4 (32)	10000 (703)	3”–300# ANSI FLANGE	1–13/16” API 10000# RJ FLANGE
TFEF – HP BLOCK STEEL (CLAMPED IN VALVES)	2 (54)	4190 (295)	1–1/4 (32)	7500 (528)	3”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL
TFEG – STEEL–EXTRA HIGH PRESSURE BLOCK (CLAMPED IN VALVES)	1–1/2 (38)	7445 (523)	1 (25)	12000 (842)	2”–3000# SAE 4 Bolt FLANGE	(4) 3/4” Bolts 4.50 DBC SPECIAL

REBUILDING DATA FOR TFE (GD200T) PUMPS

PUMP MODEL	TFE (GD200T)	TFE (GD200T)
PUMP STROKE	5 IN.	127 mm

	INCHES	**METRIC (mm)**
Crankpin Diameter	5.495/5.496	139.573/139.598
Crankpin Width	3.504/3.515	89.002/89.281
Crankshaft Diameter at Main Bearing	4.2515/4.2525	107.9881/108.0135
Distance Between Main Bearings	21.875/21.885	555.625/555.879
Bore in Housing for Main Bearing	8.373/8.375	212.674/212.725
Connecting Rod Centers	13.0625	331.7875
Bore in Connecting Rod for Crosshead Pin	3.000/3.002	76.200/76.251
Bore in Connecting Rod for Insert	5.752/5.753	146.100/146.126
Crosshead Pin Diameter	3.0000/3.0005	76.2000/76.2127
Crosshead Pin Bushing Bore (Honed)	3.0015/3.0020	76.2381/76.2508
Bore in Crosshead for Bushing	3.374/3.375	85.699/85.725
RUNNING CLEARANCES – ACTUAL*:		
Crankpin Bearing	.0046/.0080	.1168/.2032
Crankpin Bearing Width Clearance	.007/.023	.178/.584
Crosshead Pin to Bushing	.0010/.0020	.0254/.0508
Main Bearing End Clearance	.002/.004	.051/.102
Crosshead to Frame	.006/.011	.152/.279

* Feeler gauge clearances .001 inch or .025 mm less than actual values.

TFE (GD200T)

MODEL DESCRIPTION	TFEA LP ALUMINUM BRONZE		TFEB MP ALUMINUM BRONZE		TFEC HP BLOCK STEEL		TFEF HP BLOCK STEEL		TFEG XHP BLOCK STEEL	
DISCHARGE VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.750	(120.650)	4.125	(104.775)	3.125	(79.375)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
SUCTION VALVE SEAT										
GAGE DIAMETER – IN (mm)	4.125	(104.775)	3.125	(79.375)	2.625	(66.675)	2.900	(73.66)	2.320	(58.928)
GAGE DIAMETER – IN/FT (mm/M)	1.50	(38.10)	1.50	(38.10)	1.50	(38.10)	CIV		CIV	
FLUID CYLINDER TO FRAME NUTS										
THREAD SIZE – IN (mm)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	700	(950)	700	(950)	700	(950)	700	(950)	700	(950)
STUFFING BOX TO FLUID NUTS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	3/4–10	(19.05)	1–8	(25.4)	1–8	(25.4)	1–8	(25.4)
TORQUE–DRY FT–LB (Nm)	90	(122)	300	(407)	700	(950)	700	(950)	700	(950)
DISCHARGE VALVE COVER NUTS										
THREAD SIZE – IN (mm)	1–1/8–7	(28.5)	1–1/8–7	(28.5)	1–8	(25.4)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	1000	(1355)	1000	(1355)	700	(950)				
DISCHARGE MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)							1360	(1845)	1360	(1845)
DISCHARGE FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.05)	7/8–9	(22.2)	3/4–10	(19.05)	3/4–10	(19.05)	3/4–10	(19.05)
TORQUE–DRY FT–LB (Nm)	260	(352)	430	(583)	260	(352)	380	(515)	380	(515)
SUCTION VALVE COVER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		N/A		N/A		N/A	
TORQUE–DRY FT–LB (Nm)										
SUCTION MANIFOLD TO CYLINDER NUTS										
THREAD SIZE – IN (mm)	N/A		N/A		1/2–13	(12.7)	1–1/4–7	(31.75)	1–1/4–7	(31.75)
TORQUE–DRY FT–LB (Nm)					75	(101)	1360	(1845)	1360	(1845)
SUCTION FLANGE FASTENERS										
THREAD SIZE – IN (mm)	3/4–10	(19.05)	5/8–11	(15.88)	3/4–10	(19.05)	5/8–11	(15.88)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	260	(352)	150	(203)	260	(352)	220	(298)	110	(149)
PLATE OR DISC TYPE VALVES – RETAINER TO SEAT FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	3/8–16	(9.5)	N/A		N/A	
TORQUE–DRY FT–LB (Nm)	20	(27)	20	(27)	15	(20)				
WING–GUIDED VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
SEVERE DUTY VALVES–CAGE TO SEAT										
TORQUE–DRY FT–LB (Nm)	40	(54)	40	(54)	40	(54)	N/A		N/A	
PLUNGER COUPLING FASTENER										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	50	(67)	50	(67)	50	(67)	50	(67)	50	(67)
CONNECTING ROD CAP FASTENERS										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
CONNECTING ROD PINCH BOLT										
THREAD SIZE – IN (mm)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)	1/2–13	(12.7)
TORQUE–DRY FT–LB (Nm)	75	(101)	75	(101)	75	(101)	75	(101)	75	(101)
EXTENSION ROD TO CROSSHEAD										
THREAD SIZE – IN (mm)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)	1–3/8–8	(34.9)
TORQUE–DRY FT–LB (Nm)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)	150–200	(204–271)

FASTENER TORQUES
UNLESS OTHERWISE SPECIFIED
ALL PUMPS (GRADE 5)

THREAD SIZE		TORQUE DRY	
INCHES	**mm**	**FT. LB.**	**Nm**
3/8 – 16	9.5	30	40
1/2 – 13	12.7	75	102
9/16 – 12	14.3	110	149
5/8 – 11	15.8	150	203
3/4 – 10	19.0	260	352
7/8 – 9	22.2	430	583
1 – 8	25.4	640	867
1–1/8 – 7	28.6	800	1084
1–1/4 – 7	31.8	1120	1518

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver Machinery Inc. (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment, been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted directly to the manufacturer.

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

Except for the products or components listed below, the Warranty Period for all products is 1,250 hours of operation or three (3) months after start–up, not to exceed 120 days after delivery to Purchaser, whichever occurs first. The exceptions are as follows:

1. Power end is warranted for twelve (12) months from date of start–up or eighteen (18) months from date of delivery to the Purchaser, whichever occurs first.
2. Forged steel fluid cylinder is warranted for 90 days from date of installation.
3. Expendable fluid end parts, including, but not limited to, valves, valve parts, packing, liners and pistons, are not covered by this warranty due to variable abrasive nature of material pumped.

LABOR TRANSPORTATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel, for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.

Labor costs in excess of the Company rate schedules caused by, but not limited to, location or inaccessibility of the equipment, or labor provided by unauthorized service personnel is not provided for by this warranty.

All costs of transportation of product or parts claimed not to be as warranted and, of repaired or replacement parts to or from such service facility shall be borne by the Purchaser. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by the Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of this warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components.

WARRANTY REGISTRATION VALIDATION

A warranty registration form is provided with each machine. The form must be completed by the Purchaser and mailed within ten days after machine start–up to validate the warranty.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

Gardner Denver

For additional information contact your local representative or
Gardner Denver Machinery Inc., Customer Service Department,
1800 Gardner Expressway, Quincy, Illinois 62301
Telephone: (800) 682-9868 FAX: (217) 224-7814

Sales and Service in all major cities.

For parts information, contact Gardner Denver,
Master Distribution Center, Memphis, TN
Telephone: (800) 245-4946 FAX: (901) 542-6159

Litho in U.S.A.